PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2002-059205**
(43)Date of publication of application : **26.02.2002**

(51)Int.Cl. **B21B 28/04**
B24B 5/37

(21)Application number : **2001-187454**
(22)Date of filing : **04.11.1994**

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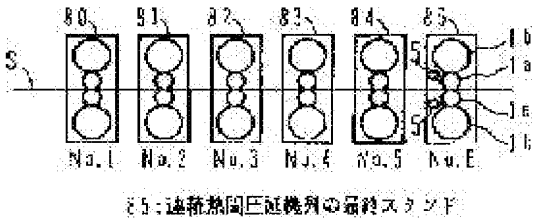
(54) **METHOD AND DEVICE FOR ON-LINE GRINDING ROLLING MILL ROLL AND ROLLING MILL ARRAY**

(57)Abstract:
PROBLEM TO BE SOLVED: To roll a rolled stock having excellent surface quality even when rolling rolls are ground at the final stand of a continuous hot-rolling mill array or a temper rolling mill in a method and device for on-line grinding rolling rolls.
SOLUTION: In the rolling mill, each of rolling mill rolls 1a is provided with a grinding unit 5 having a plane type or a cup type rotary grinding wheel 20, then the rolling rolls are on-line ground. The rotary grinding wheel 20 of the grinding unit 5 has a thin-plat disk 52 and an annular abrasive grain layer 51 which is fixed to the side face of the thin-plate disk 52 and made by hardening the abrasive grains of cubic boron nitride or diamond using a resin bond for a binder. The size of the abrasive grain in the abrasive grain layer 51 is either No.170/200 or No.200/230. Furthermore, the width (the width of the grinding wheel) W in the radial direction of the annular abrasive grain layer 51 is taken as 30-50 mm. This grinding unit is installed on the final stand of the continuous hot-rolling mill train or the temper rolling mill.



* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]In a rolling mill, a grinding unit which has a flat-surface type or a cup type emery wheel stone to a reduction roll is provided, In an on-line reduction roll grinding method which grinds said reduction roll by pushing against said reduction roll, rotating said emery wheel stone, and moving to a roll axial direction, What has the abrasive grain layer which combined a cubic boron nitride abrasive grain or a diamond abrasive grain by resin bonding is used as an emery wheel stone of said grinding unit, An on-line reduction roll grinding method making size of said abrasive grain into either No. 170/200 and No. 200/230, installing said grinding unit in a last stand or a temper rolling mill of a continuous hot rolling mill sequence, and grinding a reduction roll.
[Claim 2]A grinding unit characterized by comprising the following which has a flat-surface type or a cup type emery wheel stone to a reduction roll in a rolling mill is provided, An on-line reduction roll grinding method which grinds said reduction roll by pushing against said reduction roll, rotating said emery wheel stone, and moving to a roll axial direction.
A disk which rotates with said grinding stone driving device as an emery wheel stone of said grinding unit.
An annular abrasive grain layer which was attached to the side of this disk and combined a cubic boron nitride abrasive grain or a diamond abrasive grain by resin bonding.

[Claim 3]In a rolling mill, a grinding unit which has a flat-surface type or a cup type emery wheel stone to a reduction roll is provided, In an on-line reduction roll grinding method which grinds said reduction roll by pushing against said reduction roll, rotating said emery wheel stone, and moving to a roll axial direction, An on-line reduction roll grinding method providing one of said grinding unit to one reduction roll, installing the grinding unit in a last stand or a temper rolling mill of a continuous hot rolling mill sequence, and grinding a reduction roll overall length with one emery wheel stone.
[Claim 4]A flat-surface type or a cup type emery wheel stone which has the grinding unit provided to a reduction roll in a rolling mill and with which said grinding unit grinds said reduction roll.
A grinding stone driving device made to rotate said emery wheel stone.
A grinding stone feed gear which pushes said emery wheel stone against said reduction roll.
A traverse device made to move said grinding unit to a roll axial direction along with a sliding rail.
Are the on-line reduction roll grinding attachment provided with the above, and said emery wheel stone has the abrasive grain layer which combined a cubic boron nitride abrasive grain or a diamond abrasive grain by resin bonding, Size of said abrasive grain is made into either No. 170/200 and No. 200/230, and it is installed in a last stand or a temper rolling mill of a continuous hot rolling mill sequence.

[Claim 5]A flat-surface type or a cup type emery wheel stone which has the grinding unit provided to a reduction roll in a rolling mill and with which said grinding unit grinds said reduction roll.
A grinding stone driving device made to rotate said emery wheel stone, a grinding stone feed gear which pushes said emery wheel stone against said reduction roll, and a traverse device made to move said grinding unit to a roll axial direction along with a sliding rail.
Are the above the on-line reduction roll grinding attachment which it had, and said emery wheel stone, It is attached to the side of a disk which rotates with said grinding stone driving device, and this disk, It shall have the annular abrasive grain layer which combined a cubic boron nitride abrasive grain or a diamond abrasive grain by resin bonding, width of a diameter direction of said annular abrasive grain layer shall be 30 mm - 50 mm, and it is installed in a last stand or a temper rolling mill of a continuous hot rolling mill sequence.

[Claim 6]A flat-surface type or a cup type emery wheel stone which has the grinding unit provided to a reduction roll in a rolling mill and with which said grinding unit grinds said reduction roll.
A grinding stone driving device made to rotate said emery wheel stone.
A grinding stone feed gear which pushes said emery wheel stone against said reduction roll.
A traverse device made to move said grinding unit to a roll axial direction along with a sliding rail.
It is the on-line reduction roll grinding attachment provided with the above, and was installed in a last stand or a temper rolling mill of a continuous hot rolling mill sequence, and one of said grinding unit was provided to one reduction roll.

[Claim 7]A rolling mill train installing on-line reduction roll grinding attachment characterized by comprising the following in a last stand.
A flat-surface type or a cup type emery wheel stone which has the grinding unit provided to a reduction roll in a rolling mill and with which said grinding unit grinds said reduction roll.
A grinding stone driving device made to rotate said emery wheel stone.
A grinding stone feed gear which pushes said emery wheel stone against said reduction roll.
A traverse device made to move said grinding unit to a roll axial direction along with a sliding rail.

[Claim 8]A flat-surface type or a cup type emery wheel stone which has the grinding unit provided to a reduction roll in a rolling mill and with which said grinding unit grinds said reduction roll, A grinding stone driving device made to rotate said emery wheel stone and a grinding stone feed gear which pushes said emery wheel stone against said reduction roll, It has a traverse device made to move said grinding unit to a roll axial direction along with a sliding rail, A rolling mill train which installed on-line reduction roll grinding attachment which said emery wheel stone has the abrasive grain layer which combined a cubic boron nitride abrasive grain or a diamond abrasive grain by resin bonding, and made size of said abrasive grain either No. 170/200 and No. 200/230 in a last stand.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to an on-line reduction roll grinding method, a device, and a rolling mill train, and relates to the rolling mill train provided with an on-line reduction roll grinding method, a device, and on-line reduction roll grinding attachment suitable for grinding a reduction roll to the optimal shape and surface disposition for rolling especially.
[0002]
[Description of the Prior Art]Generally, if slab material is rolled, only a rolling portion will be worn out and a level difference with a non-rolling portion will produce the reduction roll of a plate mill. For this reason, there were restrictions on rolling, such as attaching and rolling turn in narrow slab from broad slab. Many on-line roll grinding methods and devices are proposed that this problem should be solved.
[0003]For example, to JP,5-104115,A "roll grinding method in an on-line roll grinder device." Have a roll profile arithmetic unit and a difference with the roll profile made into the roll profile measured on-line and the purpose is searched for, The grinding method which determines the position with ** of a grinding stone for every oscillation of a roll axial direction from this difference, and changed the grinding position is proposed (henceforth the 1st conventional technology).
[0004]To JP,3-73364,B "reduction roll grinding method." Using two or more grinding bodies allocated along the axis of a reduction roll, the plate-leaping part (rolling part) of rolled stock is ground to such an extent that it can remove the dry rough skin of a roll surface, and the grinding method with which the level difference part with a non-plate-leaping part enlarges forcing power of a grinding body as compared with a plate-leaping part is described (henceforth the 2nd conventional technology).
[0005]
[Problem(s) to be Solved by the Invention]However, there are the following problems in the above-mentioned conventional technology.
[0006]If slab material is rolled, only a rolling portion will be worn out, and a level difference with a non-rolling portion will arise, but at this time, if the slab material of identical width is rolled, from the portion of everything [position / equivalent to the part of a plate edge of rolled stock] but a rolling part, abrasion loss of the reduction roll of a plate mill will increase further, and it will produce an excessive abrasion level difference. For this reason, it transfers to rolled stock, the edge build up in which board thickness is thicker than the portion of others [end / rolled stock] arises, and board thickness becomes uneven.
[0007]In the 1st conventional technology of the above, if the roll profile in which the reduction roll was worn out is measured on-line and there is a difference with a predetermined roll profile, it will grind by calculating and deciding the position which the grinding body to a reduction roll forces by the size of the difference, and is ground, and the position which is not ground. According to this method, the excessive abrasion level difference leading to an edge build up can carry out grinding removal, but the ground portion and the portion which is not ground are made in the roll surface of a rolled stock plate-leaping part, a roll surface serves as uneven granularity, and a good surface disposition is not acquired.
[0008]In the 2nd conventional technology of the above, since a plate-leaping part is the grinding power of the grade which removes dry rough skin, the excessive abrasion level difference of the reduction roll made into the plate edge part position of rolled stock is unremovable. For this reason, an excessive abrasion level difference cannot remain in a reduction roll, and the above edge BURUDO rise itself cannot be prevented. In this conventional technology, since it grinds using two or more grinding bodies allocated along the axis of a

reduction roll, a lap mark arises in the position which the grinding position of two or more grinding bodies overlaps on a roll surface, and roll surface description with good fashion is not acquired.
[0009]By the way, if roll surface granularity becomes uneven, or a lap mark etc. occur and a surface disposition gets worse on the occasion of grinding of a reduction roll as mentioned above, it will transfer to rolled stock and will affect the surface quality of rolled stock. The plate rolled especially in the last stand and temper rolling mill of a continuous hot rolling mill sequence which serve as a product as it is. Since gloss difference comes out to the rolled stock surface or the lap mark of a grinding eye or two or more grinding stones can be seen if the roll surface description after being ground transfers on the rolled stock surface, it is requested strongly that grinding conditions which affect the surface quality of rolled stock are avoided and ground.
[0010]The 1st purpose of this invention is to provide the rolling mill train provided with the on-line reduction roll grinding method which can grind a reduction roll to a good surface disposition without surface roughness or grinding nonuniformity, a device, and its on-line reduction roll grinding attachment.
[0011]The 2nd purpose of this invention is to provide the rolling mill train provided with the on-line reduction roll grinding method which can roll rolled stock with good surface quality, a device, and its on-line reduction roll grinding attachment, even if it grinds a reduction roll with the last stand and temper rolling mill of a continuous hot rolling mill sequence.
[0012]
[The means for solving an invention] In order to attain the 1st and 2nd purposes of the above, the grinding method of this invention, In a rolling mill, the grinding unit which has a flat-surface type or a cup type emery wheel stone to a reduction roll is provided, In the on-line reduction roll grinding method which grinds said reduction roll by pushing against said reduction roll, rotating said emery wheel stone, and moving to a roll axial direction, What has the abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding is used as an emery wheel stone of said grinding unit, Size of said abrasive grain is made into either No. 170/200 and No. 200/230, said grinding unit is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and a reduction roll is ground.
[0013]In order to attain the 1st and 2nd purposes of the above, the grinding method of this invention, The disk which rotates with said grinding stone driving device as an emery wheel stone of said grinding unit, It is attached to the side of this disk and what has the annular abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding is used, The width of the diameter direction of said annular abrasive grain layer shall be 30 mm - 50 mm, said grinding unit is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and a reduction roll is ground.
[0014]In order to attain the 1st and 2nd purposes of the above, the grinding method of this invention provides one of said grinding unit to one reduction roll, installs the grinding unit in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and grinds a reduction roll overall length with one emery wheel stone.
[0015]In order to attain the 1st and 2nd purposes of the above, the grinding attachment of this invention, The flat-surface type or the cup type emery wheel stone which has the grinding unit provided to the reduction roll in the rolling mill and with which said grinding unit grinds said reduction roll, A grinding stone driving device made to rotate said emery wheel stone and a grinding stone feed gear which pushes said emery wheel stone against said reduction roll, In on-line reduction roll grinding attachment provided with the traverse device made to move said grinding unit to a roll axial direction along with a sliding rail, Said emery wheel stone has the abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, makes size of said abrasive grain either No. 170/200 and No. 200/230, and is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence.
[0016]In order to attain the 1st and 2nd purposes of the above, the grinding attachment of this invention, Said emery wheel stone is attached to the side of the disk which rotates with said grinding stone driving device, and this disk, It shall have the annular abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, the width of the diameter direction of said annular abrasive grain layer shall be 30 mm - 50 mm, and it is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence.
[0017]In order to attain the 1st and 2nd purposes of the above, the grinding attachment of this invention is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and provides one of said grinding unit to one reduction roll.
[0018]In order to attain the 1st and 2nd purposes of the above, the rolling mill train of this invention, The flat-surface type or the cup type emery wheel stone which has the grinding unit provided to the reduction roll in

the rolling mill and with which said grinding unit grinds said reduction roll, A grinding stone driving device made to rotate said emery wheel stone and a grinding stone feed gear which pushes said emery wheel stone against said reduction roll, It has a traverse device made to move said grinding unit to a roll axial direction along with a sliding rail, Said emery wheel stone has the abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, and installs the on-line reduction roll grinding attachment which made size of said abrasive grain either No. 170/200 and No. 200/230 in a last stand.

[0019]

[Function]The reduction roll can do a level difference by wear in a rolling part and a non-rolling part with rolling. If continuous rolling of the steel plate of identical width is carried out, more portions equivalent to the rolled stock end of a rolling part than other portions of a rolling part will be worn out, and excessive abrasion will arise from a rolled stock end in the range of predetermined length. Although the range of the predetermined length which produces this excessive abrasion by that the plate edge part of rolled stock cools early, and becomes harder than other portions and load concentration in a plate edge part, and excessive abrasion produces changes with board thickness, the quality of a plate, etc., generally the range of it is 20 to about 50 mm from a rolled stock end. Having a thermal crown generally, it wears out uniformly and the rolling part except a rolled stock end part goes.

[0020]especially the surface disposition of the reduction roll of a last stand or a temper rolling mill is influenced also with the size of attachment ****** by the emery wheel stone to grind, and if abrasive grain size becomes fine, in connection with it, the surface disposition of a reduction roll will become good. However, in the grinding stone of not much fine abrasive grain size, the life of a grinding stone is too short and it cannot be used for actual on-line reduction roll grinding attachment.

[0021]By being what combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, making the abrasive grain layer of an emery wheel stone from this invention, and making size of an abrasive grain into either No. 170/200 and No. 200/230, A reduction roll can be ground now to a good surface disposition for a long time, and grinding capability required for the emery wheel stone attached to the on-line reduction roll grinding attachment of the last stand of a continuous hot rolling mill sequence or a temper rolling mill and a grinding stone life can be attained.

[0022]Even if it makes quick speed which moves an emery wheel stone to a roll axial direction, it is necessary to make it the delivery mark of a grinding stone not remain in a rolling roll surface.

[0023]Using what has the annular abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding as an emery wheel stone of a grinding unit in this invention by the width of the diameter direction of an annular abrasive grain layer being 30 mm - 50 mm, While sending making grinding stone movement speed quick, and not leaving a mark but grinding to a good surface disposition, it can grind without being able to secure a grinding stone life and also starting clogging uniformly. Grinding capability required for the emery wheel stone attached to the on-line reduction roll grinding attachment of the last stand of a continuous hot rolling mill sequence or a temper rolling mill by this and a grinding stone life can be attained.

[0024]By providing one grinding unit to one reduction roll, and grinding a reduction roll overall length with one emery wheel stone in this invention, Even if a reduction roll can be ground to a good surface disposition, without producing a lap mark like [in the case of grinding with two or more grinding stones] and it grinds a reduction roll with the last stand and temper rolling mill of a continuous hot rolling mill sequence, rolled stock with good surface quality is rollable.

[0025]

[Example]Hereafter, the example of this invention is described using a drawing. First, drawing 1 - drawing 10 explain the 1st example of this invention. In drawing 1 and drawing 2, the rolling mills in connection with this example are four stage rolling machines which have the reduction rolls (up-and-down work roll) 1a and 1a of the couple which extends the rolled stock S, and the reduction rolls (up-and-down reinforcement rolls) 1b and 1b (only one side is illustrated) of the couple which supports the reduction rolls 1a and 1a. The reduction rolls 1a and 1a are held by the bearing housing 3 and 3, and these bearing housing 3 and 3 is included in the operation side and the stands 4 and 4 of the driving side. The ON side guide 10 is arranged at the rolling mill ON side, and the guide to the reduction roll 1a of the rolled stock S is performed. The coolant header 15 (only one side is illustrated) which cools the heat of the reduction rolls 1a and 1a by which it is generated at the time of rolling is formed, and the heat of the reduction rolls 1a and 1a by which it is generated at the time of rolling is cooled.

[0026]The on-line reduction roll grinding attachment of this example is formed in such a rolling mill. On-line reduction roll grinding attachment has two or more grinding units 5 and 5 installed two pieces in this example in the one work roll 1a.
[0027]As shown in drawing 3 and drawing 4, each grinding unit 5, The disc-like emery wheel stone 20 which grinds the work roll 1a, and this emery wheel stone 20 via the grinding stone axis of rotation 21. It has the grinding stone driving device 22 to rotate, the grinding stone feed gear 23 which pushes the emery wheel stone 20 against the reduction roll 1a, and the traverse device 24 made to move the emery wheel stone 20 to the shaft orientations of the reduction roll 1a.
[0028]The emery wheel stone 20 has the sheet metal disk 52 which has the boss 52a, and the annular abrasive grain layer 51 fixed to the side by the side of the anti-boss of the sheet metal disk 52, and the sheet metal disk 52 is attached to the grinding stone axis of rotation 21 in the portion of the boss 52a. The sheet metal disk 52 has an elastic body function for absorbing the vibration from a reduction roll, and has the reduction roll 1a and structure which changes a flexure amount according to the contact force between the abrasive grain layers 51.
[0029]The abrasive grain layer 51 uses resin bonding for binding material, hardens the cubic boron nitride abrasive grain (generally referred to as CBN) or diamond abrasive grain which is superabrasive, and is made. The construction material of the sheet metal disk 52 is made from the aluminum material or the aluminum containing alloy for the purpose of radiating heat easily in the grinding heat from the superabrasive of the abrasive grain layer 51, and the purpose of lessening flexible region mass.
[0030]As the grinding stone axis of rotation 21 is shown in drawing 3, in order that only single-sided one side of the emery wheel stone 20 may be contacted to the reduction roll 1, minute angle ****** installation of 0.5 degree - the 1.0-degree intensity is carried out to the line right-angled in the axial center of the reduction roll 1a. By this, the line of contact of the abrasive grain layer 51 and the work roll 1a sees from the center of a grinding stone, and is formed only in one side, and, as for the sheet metal disk 52, an elastic body function can be exhibited effectively.
[0031]The hydraulic motor 54 (an electric motor may be used) rotated so that it may become a predetermined grinding stone peripheral speed about the emery wheel stone 20, as the grinding stone driving device 22 is shown in drawing 3, It has the belt pulley shaft 54b and the belt 55 which tell rotation of the output shaft 54a of the fluid motor 54 to the grinding stone axis of rotation 21, and the output shaft 54a and the belt pulley shaft 54b are connected via the parallel spline 54c. The belt pulley shaft 54b is supported by the body 59, enabling free rotation. The grinding stone axis of rotation 21 is supported movable [to shaft orientations] free [rotation in the body 59] via the slide mold radial bearings 21a and 21b. The load cell 53 which measures the contact force of the emery wheel stone 20 and the work roll 1a is arranged at the anti-emery wheel stone side of the grinding stone axis of rotation 21.
[0032]The body 59 is stored by the case 25 and the hydraulic motor 54 is attached to the case 25. The body 59 is carried in the shaft orientations of the grinding stone axis of rotation 21 movable via the slide bearing 25a at the pars basilaris ossis occipitalis of the case 25, as shown in drawing 4.
[0033]The feed motor 57 attached to the case 25 as the grinding stone feed gear 23 was shown in drawing 3, The precompression type ball screw 56 of the backlash loess type which moves the body 59 in the attachment-and-detachment direction of the work roll 1a by rotation of the feed motor 57, and carries out cross feed of the emery wheel stone 20, the grinding stone axis of rotation 21, and the load cell 53 together, It has the encoder 57a which detects angle of rotation of the feed motor 57. Backlash loess type gear mechanics may be used instead of the precompression type ball screw 56.
[0034]The traverse motor 58 attached to the case 25 as the traverse device 24 was shown in drawing 4, The pinion 58a with which the axis of rotation of the traverse motor 58 is equipped and which gears with the rack 14, It is attached to the upper surface of the case 25, and has two pairs of guide idlers 26 (refer to drawing 2) which engage with one pair of guide rails 7a and 7b, and the encoder 58b which detects the number of rotations of the traverse motor 58. The guide rails 7a and 7b are attached to the rail frames 7 by which the diameter was carried out to the ON side of the reduction roll 1a along with the axial center of the reduction roll 1a as shown in drawing 2. The rack 14 is formed in the side by the side of the anti-reduction roll of the guide rail 7a. Thus, the grinding unit 5 is smoothly made movable in the direction of the roll-axes heart by engagement of rotation of the traverse motor 58, the pinion 58a, and the rack 14, supporting to the rail frames 7 via the guide idler 26 and the guide rails 7a and 7b.
[0035]It is necessary to make it the roll grinding unit 5 not interfere with the bearing housing 3 by the side of

operation at the time of exchange of the reduction roll 1a. For this reason, the both ends of the rail frames 7 are slidably supported by the guide 9 attached to the stand 4 as shown in drawing 2, The grinding unit 5 can be moved now in the attachment-and-detachment direction of the reduction roll 1a together with the rail frames 7 with the rail moving system 30 (refer to drawing 1) of the operation side provided near the both ends of the rail frames 7, respectively, and a driving side. Each rail moving system 30 is provided with the oil hydraulic cylinder 11 by which pin connection of the tip was carried out to the rail frames 7.

[0036]The feed motor 57 of the grinding stone feed gear 22 and the traverse motor 58 of the traverse device 24 are controlled by the control device 13a to be shown in drawing 3. The hydraulic motor 54 of the grinding stone driving device 22 is driven with the fluid supplied from the hydraulic circuit 13c, and the hydraulic circuit 13c is also controlled by the control device 13a. The detecting signal of the encoder 57a of the load cell 53 and the grinding stone feed gear 23 and the encoder 58b of the traverse device 24 is sent and processed by the information processor 13b, and the result is sent to the control device 13a.

[0037]In this example constituted as mentioned above, by driving the emery wheel stone 20 positively with the grinding stone driving device 22 at high speed, grinding capability and a grinding stone life can be raised and it can grind for a long time. In this example, like the statement to JP,6-47654,A, since the emery wheel stone 20 can be ground correctly for a long time, without absorbing easily vibration which a reduction roll has and producing BIBIRI, it is effective in raising grinding capability and a grinding stone life further.

[0038]That is, the reduction roll 1a is vibrating, having the pitch of 10 to 150 C/S, although it depends also on rolling speed. When the roll grinder which has a common cylindrical grinding stone with off-line grinding attachment conventionally as on-line grinding attachment is attached, a cylindrical grinding stone and a reduction roll contact via the abrasive grain on the surface of a grinding stone, and while the metal and the abrasive grain of a roll surface collide, they come to grind.

[0039]When an abrasive grain and rolling roll surface metal contact, a reduction roll is ground, the following moment grinding stone separates from a reduction roll, and an abrasive grain cuts empty and rotates. Such discontinuous grinding will cause a BIBIRI phenomenon and will be irregular rolling roll surface and section.

[0040]If a grinding stone carries out the same vibration as vibration of a reduction roll, change of the contact force of a grinding stone and a reduction roll will not be generated. However, since reduction roll vibration is 150 c/ses and high frequency, flattery is difficult for vibrating a grinding stone and the whole grinding stone frame so that it may align with a reduction roll. If it does not try to miss vibration of a reduction roll with a grinding stone and the whole grinding stone frame, an elastic body function is given to the grinding stone itself and vibration is absorbed by bending of a grinding stone, since the mass of a flexible region becomes small, vibration of a reduction roll will be followed promptly, and change of the contact force between a grinding stone and a reduction roll will become small.

[0041]An elastic body function is given to the grinding stone itself by giving an elastic body function to the sheet metal disk 52 which are some emery wheel stones 20 in this example, Rotating this emery wheel stone 20 so that the peripheral speed of the abrasive grain layer 51 may become 1600 m/min from 1000 m/min on a periphery, it pushes against the rotating reduction roll 1a, and it is sagged. The reduction roll 1a is vibrating forward and backward as mentioned above. Although the emery wheel stone 20 is pushed by this vibration, the sheet metal disk 52 bends then and the vibration from the reduction roll 1a is absorbed in an instant. Thereby, change of the contact force between the abrasive grain layer 51 and the reduction roll 1a serves as the small range of the elastic force produced in bending of the sheet metal disk 52, and can abolish a BIBIRI phenomenon.

[0042]In this example, in order to demonstrate effectively the elastic body function of the sheet metal disk 52, the grinding stone axis of rotation 21 is leaned so that the contact position of the abrasive grain layer 51 and the reduction roll 1a may be formed only in one side from the center of a grinding stone, as shown in drawing 3. If it does in this way, the sheet metal disk 52 can be bent by pressure to the reduction roll 1a in the form of a cantilever, and the vibration from the reduction roll 1a can be absorbed easily.

[0043]Since the elastic body function is given to the sheet metal disk 52 which is base metal supporting the abrasive grain layer 51 in this example, The mass which moves by the vibration from a reduction roll serves as only the abrasive grain layer 51 and the sheet metal disk 52, And since the high superabrasive (a cubic boron nitride abrasive grain or a diamond abrasive grain) of the grinding ratio (reduction volume / grinding stone reduction volume of a structure) in which prolonged grinding is possible is used by weight small to the abrasive grain layer 51, the mass of a flexible region becomes very small and the character frequency of the emery wheel stone 20 becomes high. For this reason, it can grind correctly for a long time, without producing the

BIBIRI phenomenon according the vibrating reduction roll to resonance.
[0044]Next, the grinding method of this example is explained using drawing 5 - drawing 8.
[0045]The roll profile measured on-line is shown in drawing 5. As shown in this figure, if the reduction roll can do a level difference by wear in a rolling part (plate-leaping part) and a non-rolling part and carries out continuous rolling of the steel plate of identical width with rolling, more portions equivalent to the rolled stock end of a rolling part than other portions of a rolling part will be worn out. Generally, having a thermal crown, it wears out uniformly and a rolling part goes.
[0046]Other examples of a roll profile when the rolled stock of identical width is rolled are shown in drawing 6. This example is the roll profile measured off-line, and the thermal crown has disappeared. A dashed line is a survey roll profile among a figure, and a solid line is a theoretical roll profile (calculatively). If it continues rolling the 20 or more rolled stock (steel plate) S of identical width as shown in this figure, the wear level difference a will arise between a rolling part and a non-rolling part. If continuous rolling of the steel plate of identical width is carried out, more portions which hit rolled stock end Se than other plate-leaping parts will be worn out, and the excessive abrasion of the level difference b will arise from end Se of the rolled stock S into the portion of predetermined length c. Although this excessive abrasion is produced by that the plate edge part of rolled stock cools early, and becomes harder than other portions, and load concentration of a plate edge part and length c changes with board thickness, the quality of a plate, etc., according to an invention-in-this-application person's etc. examination, it is generally in the range of 20 to 50 mm. The inside [portion / of the length c] is worn out almost uniformly.
[0047]And it is shown in drawing 7. [the roll profile measured on-line] [a ** type] the inside of a figure, and A -- the end position of the reduction roll 1a -- B -- plate edge part Se of the rolled stock S -- only length [of excessive abrasion] c, C shows the roll axial direction middle position of the reduction roll 1a, and D shows the position of plate edge part Se of the rolled stock S for an inside position, respectively.
[0048]In order to remove first the wear level difference a produced with rolling, and the excessive abrasion level difference b in the grinding method of this example, In the range of A-D outside the portion which hits rolled stock S plate edge part Se, a required grinding amount is calculated from the difference of a target roll profile and a survey roll profile, the contact force of the reduction roll 1a and the emery wheel stone 20 is calculated from this required grinding amount, and this is ground as setting-out contact force. Since the shape change by wear is large, the contact force of the reduction roll 1a and the emery wheel stone 20 is similarly controlled by the difference of a target roll profile and a survey roll profile, and the portion of length c of excessive abrasion, i.e., the range of D-B, is ground.
[0049]since it becomes the roll profile which, on the other hand, had the curvature of about 1 law which has a thermal crown in the range of B-B inside the portion of length c of excessive abrasion, contact force of the reduction roll 1a and the emery wheel stone 20 is not changed, but it grinds by fixed contact force.
[0050]Change of contact force when it grinds as mentioned above is shown in drawing 8. Only the predetermined length containing excessive abrasion length c divides the grinding range of the reduction roll 1a into 1st range A-B of the roll axial direction outside, and 2nd range B-B of the roll axial direction inside from the both ends of a rolling part bordering on the inside roll axial direction position B, At 1st range A-B, the contact force of the reduction roll 1a and the emery wheel stone 20 is controlled by the difference of a target roll profile and a survey roll profile, and it grinds, and by 2nd range B-B, it controls and grinds so that the contact force of the reduction roll 1a and the emery wheel stone 20 may become fixed. A rolling part is ground by grinding the 2nd range by fixed contact force by the good surface disposition which does not have nonuniformity in surface roughness.
[0051]The grinding capability of 2nd range B-B that is a portion into which a rolling part is worn out almost uniformly here requires that the excessive abrasion level difference b by end Se of the rolled stock S (refer to drawing 6) should be removable. 0.6 micrometerm That is, if one coil of excessive abrasion level differences b generally made in end Se of the rolled stock S are rolled, they will be produced from 0.3. It controls to become the grinding capability for this level difference to grinding be removable. Grinding capability is decided from the axial movement speed (traverse speed) of the reduction roll 1a, and the contact force (forcing power of the emery wheel stone 20) of the emery wheel stone 20 and the reduction roll 1a of the emery wheel stone 20, or the number of rotations of the emery wheel stone 20. Therefore, the fixed contact force in 2nd range B-B is set up become the grinding capability for the excessive abrasion level difference b made in rolled stock end position to be removable.
[0052]The level difference part of the roll profile produced by wear can be made flat, without changing the form

of a thermal crown by grinding the reduction roll 1a as mentioned above.
[0053]The reduction roll grinding attachment of this example enforces the above grinding method, and shows drawing 9 the control procedure with a flow chart. These control procedures are beforehand stored in the information processor 13b as a program.
[0054]First, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a, and the profile of a roll overall length is measured (Step 100). The roll profile measuring method performed using the grinding attachment of this on-line can use the method of a statement for JP,6-47654,A, and mentions it later about that example. Next, the required grinding amount between A-B is calculated from the difference of a target roll profile and a survey roll profile, the contact force of the reduction roll 1a and the emery wheel stone 20 is calculated from this required grinding amount, and this is made into setting-out contact force (Step 101). The position of a target roll profile and B is beforehand memorized to the information processor 13b. Subsequently, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a, and grinding is started (Step 102). At this time, the information processor 13b always recognizes the grinding position of a roll axial direction from the detecting signal of the encoder 58b of the traverse motor 58 (Step 103), The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force of the reduction roll 1a and the emery wheel stone 20 which were measured by the load cell 53 turns into contact force which calculated as mentioned above and was set up, when a grinding position is between A-B (Step 104). The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force measured by the load cell 53 turns into fixed contact force, when a grinding position is between B-C (Step 105). The fixed contact force is also beforehand memorized to the information processor 13b. If grinding of a roll overall length is completed, the number of times of grinding will be counted (Step 106,107), and it is judged whether the number of times of grinding reached the number of times of specification (Step 108). The number of times of specification grinding is 5 to 6 times, and this number of times is also beforehand memorized to the information processor 13b. If it returns to Step 102, processing of the above-mentioned steps 103-108 is repeated and the number of times of specification is reached when the number of times of grinding does not reach the number of times of specification, it will return to Step 100, a roll profile will be measured again, and processing of the above-mentioned steps 101-108 will be repeated. It continues during rolling and the above roll grinding is carried out.
[0055]An example of the procedure of the roll profile measurement in Step 100 is explained using drawing 10. This procedure is also stored in the information processor 13b as a program. First, the emery wheel stone 20 of one grinding unit 5 is pushed against the operation side edge part of the work roll 1a (Step 300). Next, the traverse motor 58 is rotated and the grinding unit 5a is moved to a roll axial direction (Step 301). The contact force of the abrasive grain layer 51 and the work roll 1a is measured by the load cell 53 during this movement, A feed position is controlled by the feed motor 57 so that the contact force becomes fixed (Step 302), and the feed per revolution of the emery wheel stone 20 is computed with the signal from the encoder 57a of the feed motor 57 (Step 303). It can come, simultaneously the position of the roll axial direction of the grinding unit 5a is measured with the signal from the encoder 58b of the traverse motor 58 (Step 304). And a roll profile is computed from the position of a roll axial direction, and the feed per revolution of an emery wheel stone (Step 305). A procedure with the same said of the grinding unit 5 of another side is carried out, and a roll profile is computed (Step 306). However, movement of a roll axial direction is performed from a driving-side end. The roll profile for which it asked by movement of the two grinding units 5 and 5 is compounded, and the profile of the overall length of the work roll 1a is determined (Step 307). On-line grinding attachment can be used by the above, and the profile of a reduction roll can be measured on-line.
[0056]It may be the method of fixing a feed position to JP,6-47654,A like a statement as a method of measuring a roll profile using on-line grinding attachment, and measuring change of contact force. An on-line profile meter for exclusive use may be installed, and the detection value may be used.
[0057]A reduction roll can be ground to the optimal roll profile and surface disposition for rolling, without not leaving the excessive abrasion level difference which causes an edge build up by the above according to this example, and changing the form of a thermal crown.
[0058]In the last stand and temper rolling mill of a continuous hot rolling mill sequence, the homogeneity of the board thickness of rolled stock, the gloss on the surface of rolled stock, and surface roughness are greatly influenced according to the roll profile and surface disposition of the reduction roll ground by on-line reduction roll grinding attachment. By forming the on-line reduction roll grinding attachment of this example in the last

stand and temper rolling mill of a continuous hot rolling mill sequence, and grinding a reduction roll, rolled stock with uniform board thickness and good surface quality can be manufactured.

[0059]Drawing 11 explains the 2nd example of this invention.

[0060]In the 1st example, it is ground in the range of B-C by the same shape as the worn-out shape by only predetermined length's fixing contact force in 2nd inside range B-C, and grinding it bordering on the inside roll axial direction position B, from end Se of the rolled stock S. Therefore, this method is a convenient method when it wears out in right-and-left homogeneity in the range of B-C. However, it is necessary to grind so that it may become a symmetrical roll profile, when not wearing out uniformly in the range of B-C but wearing out in right-and-left unevenness. Therefore, it is necessary to set up a target roll profile, and to change and grind the contact force of the reduction roll 1a and the emery wheel stone 20 by a place from the difference of a target roll profile and a survey roll profile also in this range. However, when the difference of the contact force of the reduction roll 1a and the emery wheel stone 20 is enlarged too much by a place even in this case, in the case of a rolling part, a reduction roll 1a surface disposition changes by a place, and there is a possibility that this may transfer to the rolled stock S and may worsen surface quality.

[0061]By changing the gain which calculates the contact force of the reduction roll 1a and the emery wheel stone 20 in the range of A-B of a roll end, and the range of B-C of a rolling part even if the difference of a target roll profile and a survey roll profile is the same in the grinding method of this example, the difference of the contact force with a small rolling part in which a roll end becomes a difference of bigger contact force -- it is made to become Since the roll profile error by grinding also becomes small even when the roll profile measured by making small the gain which calculates the contact force of a rolling part has an error, Change of the roll surface description in a rolling part decreases, and rolled stock with good surface quality can be manufactured.

[0062]A flow chart shows the control procedure of the reduction roll grinding attachment for enforcing the above-mentioned grinding method to drawing 11.

[0063]First, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a like the 1st example, and the profile of a roll overall length is measured (Step 500). Next, the required grinding amount between A-B and between B- is calculated from the difference of a target roll profile and a survey roll profile, The contact force setting-out gain G is changed, contact force is calculated so that change of the contact force over the roll profile difference between B-C more nearly same than between [this required grinding amount to] A-B may become small, and this is made into setting-out contact force (Step 501). That is, when Z'(x) and a contact force transformation constant are set to K and a gain is set [a target roll profile] to G1 and G2 for Z(x) and a survey roll profile, between A-B, it is $P(x)=KG1\{Z(x)-Z'(x)\}$. -- (1)

It comes out, contact force P(x) is calculated, and it is $P(x)=KG2$ between B-C $\{Z(x)-Z'(x)\}$. -- (2)

It comes out and contact force P(x) is calculated. Here, $\{Z(x)-Z'(x)\}$ is the difference of a target roll profile and a survey roll profile, i.e., a required grinding amount, and the gain G1 and G2 have a relation of $G1>G2$. It is set as $G1=1$ and $G2=0.5$ as an example. The above-mentioned formula (1) and (2) is beforehand memorized to the information processor 13b with the position of the gain G1, G2, and B.

[0064]Subsequently, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a, and grinding is started (Step 502). At this time, the information processor 13b always recognizes the grinding position of a roll axial direction from the detecting signal of the encoder 58b of the traverse motor 58, The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force of the reduction roll 1a and the emery wheel stone 20 which were measured by the load cell 53 turns into contact force calculated and set up by the above-mentioned formula (1), when a grinding position is between A-B, The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force measured by the load cell 53 turns into contact force calculated by (2) in above one, when a grinding position is between B-C (Step 503). If grinding of a roll overall length is completed, the number of times of grinding will be counted (Step 504,505), and it is judged whether the number of times of grinding reached the number of times of specification (Step 506). The number of times of specification grinding is 5 to 6 times, and this number of times is also beforehand memorized to the information processor 13b. If it returns to Step 502, processing of the above-mentioned steps 503-506 is repeated and the number of times of specification is reached when the number of times of grinding does not reach the number of times of specification, it will return to Step 500, a roll profile will be measured again, and processing of the above-mentioned steps 501-506 will be repeated. It continues during

rolling and the above roll grinding is carried out.
[0065]A reduction roll can be ground to the optimal roll profile and surface disposition for rolling, without not leaving the excessive abrasion level difference which causes an edge build up also by this example, and changing the form of a thermal crown by the above. Even if it grinds the last stand of a continuous hot rolling mill sequence, and the reduction roll of a temper rolling mill, grinding of the on-line which keeps the surface quality of rolled stock good is attained.
[0066]Drawing 12 - drawing 15 explain the 3rd example of this invention. This example installs the rolling mill provided with the on-line reduction roll grinding attachment of this invention in the last stand of a continuous hot rolling mill sequence.
[0067]In drawing 12, the continuous hot rolling mill sequence of this example arranges six sets of the rolling mills 80-85 to the 6th stand to a tandem, and comprises the 1st stand, and the on-line reduction roll grinding attachment of this invention is formed in the rolling mill 85 of the last stand (the 6th stand). This reduction roll grinding attachment has the grinding unit 5 arranged one piece at a time to the up-and-down reduction rolls 1a and 1a, respectively. The composition of others of reduction roll grinding attachment including the composition of the grinding unit 5 is the same as the 1st example except for the point that the control device 13a and the information processor 13b (refer to drawing 3) function as controlling to grind the overall length of the reduction roll 1a with the one grinding unit 5.
[0068]In drawing 13, the emery wheel stone 20 of the grinding unit 5, As the 1st example explained, it is attached to the side of the sheet metal disk 52 and the sheet metal disk 52, and have the annular abrasive grain layer 51 which used resin bonding for binding material, hardened the cubic boron nitride abrasive grain or the diamond abrasive grain, and was made, but. The sizes of the abrasive grain of the abrasive grain layer 51 are either No. 170/200 and No. 200/230. The width (grinding stone width) W of the diameter direction of the annular abrasive grain layer 51 is 30 mm - 50 mm.
[0069]Since the reduction roll 1a surface disposition which was ground unlike other stands transfers to the rolled stock S when on-line reduction roll grinding attachment is formed in the last stand of a continuous hot rolling mill sequence, More than on-line reduction roll grinding attachment heightens grinding capability, to maintain a reduction roll 1a surface disposition good is desired.
[0070]The experimental result about the difference in the roll surface grinding relative roughness by the difference in the abrasive grain particle size of a grinding stone is shown in drawing 14. The range of the arrow at a given abrasive grain particle size of this figure shows the range of roll surface relative roughness. The experimental result about the relation between the difference in the abrasive grain particle size of a grinding stone and the difference in a grinding ratio (abrasion loss of ********/grinding stone of a structure) is shown in drawing 15. The range of the arrow at a given abrasive grain particle size shows the range of a grinding ratio. The grinding conditions in these experimental results are as follows.
roll (abrasives): -- nickel grain roll roll-rotational-speed: -- 300 - 600 m/min grinding stone revolving speed: -- 1200 m/min contact force: -- 300N grinding stone traverse speed: -- 10 - 20 mm/s upcutting grinding (it grinds in the state where the hand of cut and grinding stone hand of cut of a roll are reverse)
Grinding-stone width: 40 mm.
[0071]According to an invention-in-this-application person's etc. examination, when the reduction roll 1a surface disposition ground by on-line reduction roll grinding attachment in the last stand was from average-of-roughness-height Ra0.9micrometerm in the surface state with unevenness more than 1.0 micrometerm, it turned out that this unevenness transfers to the rolled stock S as a grinding eye. For this reason, in order to avoid this, it is necessary to grind a reduction roll 1a surface disposition in the state of unevenness below 1.0 micrometerm from average-of-roughness-height Ra0.9micrometerm. It is needed that the particle size of the abrasive grain of the abrasive grain layer 51 made with cubic boron nitride (CBN) or a diamond abrasive grain from drawing 14 is finer than this including #170/200. On the other hand, if the particle size of an abrasive grain is made fine, the average of roughness height of the reduction roll 1a will improve, but as shown in drawing 15, **** of an abrasive grain becomes early rapidly. This is because binding material is resin bonding when an abrasive grain becomes small, so the power supporting an abrasive grain becomes small, an abrasive grain is easily omitted and wear of the abrasive grain layer 51 becomes early. an abrasive grain particle size -- # -- since a grinding stone life will be 2 or 3 days and exchange of a grinding stone is frequently needed when it becomes fine 230/270 or more, it will be necessary to stop rolling for grinding stone exchange, and the effect of on-line roll grinding attachment will be lost greatly.
[0072]As mentioned above, grinding capability required for the emery wheel stone 20 attached to the on-line

reduction roll grinding attachment of a last stand and a grinding stone life can be attained by making the abrasive grain particle size of the abrasive grain layer 51 in the emery wheel stone 20 into No. 170/200 or No. 200/230.

[0073]When the distance which an emery wheel stone moves during 1 rotation of the reduction roll 1a in a roll axial direction became 1/3 or more [of the width W of the abrasive grain layer 51, i.e., grinding stone width,] according to an invention-in-this-application person's etc. examination, it turned out that it is easy to generate the delivery mark of a grinding stone. At for example, the time of the roll diameter of 700 mm, and roll-rotational-speed 300 m/min. The roll axial direction movement speed (permission grinding stone movement speed) of the emery wheel stone 20 in case the grinding stone width W shall be 20 mm, 30 mm, and 40 mm and only /3 of the grinding stone width W moves, Respectively, it is grinding stone width W20mm. Permission grinding stone movement speed It can become 15 mm/s 30mm 22.7 mm/s 40mm 30 mm/s 50mm 37.5 mm/s 60mm 45.4 mm/s, it can send, so that the grinding stone width W is wide, and it cannot leave a mark, but grinding stone movement speed can be made quick.

[0074]On the other hand, even if the emery wheel stone 20 makes the same contact force of the abrasive grain particle size of the abrasive grain layer 51, the reduction roll 1a, and the emery wheel stone 20, the life of a grinding stone changes with grinding stone width W. For example, even if it grinds the reduction roll 1a with the grinding stone of #170/200 with a CBN abrasive grain, it becomes the grinding ratio 120 at grinding stone 40 mm in width to the grinding ratio 50 by grinding stone 20 mm in width. That is, when the one where grinding stone width is wider does not come out of grinding stone movement speed as much as possible quickly as mentioned above, a grinding ratio becomes large and the same grinding capability is required for this reason, in the one where grinding stone width is wider, a grinding stone life becomes a long time. However, if grinding stone width W is made large too much, a peripheral-wheel-speed difference becomes large by the peripheral part and inner periphery of the annular abrasive grain layer 51, it will become difficult to contact uniformly and to grind or clogging will arise in the inside to which peripheral wheel speed becomes slow relatively.

[0075]As mentioned above, while sending the grinding stone width W of 30 to 50 mm being good, and especially around 40 mm being the optimal, and making grinding stone movement speed quick by this, and not leaving a mark but being able to grind the reduction roll 1a to a good surface disposition, It can grind without being able to secure a grinding stone life and also starting clogging uniformly.

[0076]In the last stand of continuous rolling equipment, it can prevent being ground and a roll surface transferring a grinding eye etc. to the rolled stock S by grinding using the emery wheel stone 20 which attached the above abrasive grain layers 51. However, if it grinds using two or more emery wheel stones 20 to the one reduction roll 1a, the place in which the emery wheel stone 20 carries out a lap on the reduction roll 1a surface will be generated. The surface disposition of the reduction roll 1a of this position that carried out the lap differs from others, though very small. At this example, it grinds with the one emery wheel stone 20 to the one reduction roll 1a from one end of the reduction roll 1a to the end of another side with the rolling mill of the severe above-mentioned last stand of the surface disposition of the rolled stock S. The rolled stock S which has good surface quality by this is rollable.

[0077]Although this invention was applied to the last stand of continuous hot rolling equipment as a severe rolling mill of the surface disposition of the rolled stock S in the 3rd example, if it is a severe rolling mill of the surface disposition of the rolled stock S, this invention is applicable besides it. For example, the same effect is acquired even if it applies this invention to a temper rolling mill, although a graphic display is not carried out.

[0078]Although some desirable examples of this invention were described above, it can change variously within the limits of the pneuma of above-mentioned example this invention. For example, although it shall have the flat-surface type emery wheel stone which attached the abrasive grain layer annular in a sheet metal disk as an emery wheel stone in the above-mentioned example, this invention can be similarly applied to the cup type emery wheel stone which attached the cup type grindstone member to the base circle board, and the same effect can be acquired.

[0079]

[Effect of the Invention]In this invention, the rolling roll surface can maintain the surface disposition which always does not have surface deterioration by grinding.

Therefore, an improvement of a wear level difference and the improvement of surface roughness can perform rolling of identical width material continuously without restriction.

[0080]Even if it grinds the last stand of continuous rolling equipment, and the reduction roll of a temper rolling

mill on-line, the surface disposition of a reduction roll can transfer on the rolled stock surface, surface quality can deteriorate by neither gloss difference nor a grinding eye, and rolled stock with good surface quality can be manufactured.

[0081]Even if it grinds the last stand of continuous rolling equipment, and the reduction roll of temper rolling equipment on-line, By grinding an overall length using one emery wheel stone to the roll of one, it can grind to the surface disposition of a high-definition reduction roll without a lap mark, and the rolled stock of good surface quality can be rolled.

[Translation done.]

TECHNICAL FIELD

[Industrial Application]This invention relates to an on-line reduction roll grinding method, a device, and a rolling mill train, and relates to the rolling mill train provided with an on-line reduction roll grinding method, a device, and on-line reduction roll grinding attachment suitable for grinding a reduction roll to the optimal shape and surface disposition for rolling especially.

[Translation done.]

PRIOR ART

[Description of the Prior Art]Generally, if slab material is rolled, only a rolling portion will be worn out and a level difference with a non-rolling portion will produce the reduction roll of a plate mill. For this reason, there were restrictions on rolling, such as attaching and rolling turn in narrow slab from broad slab. Many on-line roll grinding methods and devices are proposed that this problem should be solved.
[0003]For example, to JP,5-104115,A "roll grinding method in an on-line roll grinder device." Have a roll profile arithmetic unit and a difference with the roll profile made into the roll profile measured on-line and the purpose is searched for, The grinding method which determines the position with ** of a grinding stone for every oscillation of a roll axial direction from this difference, and changed the grinding position is proposed (henceforth the 1st conventional technology).
[0004]To JP,3-73364,B "reduction roll grinding method." Using two or more grinding bodies allocated along the axis of a reduction roll, the plate-leaping part (rolling part) of rolled stock is ground to such an extent that it can remove the dry rough skin of a roll surface, and the grinding method with which the level difference part with a non-plate-leaping part enlarges forcing power of a grinding body as compared with a plate-leaping part is described (henceforth the 2nd conventional technology).

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]In this invention, the rolling roll surface can maintain the surface disposition which always does not have surface deterioration by grinding.
Therefore, an improvement of a wear level difference and the improvement of surface roughness can perform rolling of identical width material continuously without restriction.

[0080]Even if it grinds the last stand of continuous rolling equipment, and the reduction roll of a temper rolling mill on-line, the surface disposition of a reduction roll can transfer on the rolled stock surface, surface quality can deteriorate by neither gloss difference nor a grinding eye, and rolled stock with good surface quality can be manufactured.
[0081]Even if it grinds the last stand of continuous rolling equipment, and the reduction roll of temper rolling equipment on-line, By grinding an overall length using one emery wheel stone to the roll of one, it can grind to the surface disposition of a high-definition reduction roll without a lap mark, and the rolled stock of good surface quality can be rolled.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, there are the following problems in the above-mentioned conventional technology.
[0006]If slab material is rolled, only a rolling portion will be worn out, and a level difference with a non-rolling portion will arise, but at this time, if the slab material of identical width is rolled, from the portion of everything [position / equivalent to the part of a plate edge of rolled stock] but a rolling part, abrasion loss of the reduction roll of a plate mill will increase further, and it will produce an excessive abrasion level difference. For this reason, it transfers to rolled stock, the edge build up in which board thickness is thicker than the portion of others [end / rolled stock] arises, and board thickness becomes uneven.
[0007]In the 1st conventional technology of the above, if the roll profile in which the reduction roll was worn out is measured on-line and there is a difference with a predetermined roll profile, it will grind by calculating and deciding the position which the grinding body to a reduction roll forces by the size of the difference, and is ground, and the position which is not ground. According to this method, the excessive abrasion level difference leading to an edge build up can carry out grinding removal, but the ground portion and the portion which is not ground are made in the roll surface of a rolled stock plate-leaping part, a roll surface serves as uneven granularity, and a good surface disposition is not acquired.
[0008]In the 2nd conventional technology of the above, since a plate-leaping part is the grinding power of the grade which removes dry rough skin, the excessive abrasion level difference of the reduction roll made into the plate edge part position of rolled stock is unremovable. For this reason, an excessive abrasion level difference cannot remain in a reduction roll, and the above edge BURUDO rise itself cannot be prevented. In this conventional technology, since it grinds using two or more grinding bodies allocated along the axis of a reduction roll, a lap mark arises in the position which the grinding position of two or more grinding bodies overlaps on a roll surface, and roll surface description with good fashion is not acquired.
[0009]By the way, if roll surface granularity becomes uneven, or a lap mark etc. occur and a surface disposition gets worse on the occasion of grinding of a reduction roll as mentioned above, it will transfer to rolled stock and will affect the surface quality of rolled stock. The plate rolled especially in the last stand and temper rolling mill of a continuous hot rolling mill sequence which serve as a product as it is. Since gloss difference comes out to the rolled stock surface or the lap mark of a grinding eye or two or more grinding stones can be seen if the roll surface description after being ground transfers on the rolled stock surface, it is requested strongly that grinding conditions which affect the surface quality of rolled stock are avoided and ground.
[0010]The 1st purpose of this invention is to provide the rolling mill train provided with the on-line reduction roll grinding method which can grind a reduction roll to a good surface disposition without surface roughness or grinding nonuniformity, a device, and its on-line reduction roll grinding attachment.
[0011]The 2nd purpose of this invention is to provide the rolling mill train provided with the on-line reduction roll grinding method which can roll rolled stock with good surface quality, a device, and its on-line reduction roll grinding attachment, even if it grinds a reduction roll with the last stand and temper rolling mill of a continuous hot rolling mill sequence.

[Translation done.]

* NOTICES *

MEANS

[The means for solving an invention] In order to attain the 1st and 2nd purposes of the above, the grinding method of this invention, In a rolling mill, the grinding unit which has a flat-surface type or a cup type emery wheel stone to a reduction roll is provided, In the on-line reduction roll grinding method which grinds said reduction roll by pushing against said reduction roll, rotating said emery wheel stone, and moving to a roll axial direction, What has the abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding is used as an emery wheel stone of said grinding unit, Size of said abrasive grain is made into either No. 170/200 and No. 200/230, said grinding unit is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and a reduction roll is ground.
[0013]In order to attain the 1st and 2nd purposes of the above, the grinding method of this invention, The disk which rotates with said grinding stone driving device as an emery wheel stone of said grinding unit, It is attached to the side of this disk and what has the annular abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding is used, The width of the diameter direction of said annular abrasive grain layer shall be 30 mm - 50 mm, said grinding unit is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and a reduction roll is ground.
[0014]In order to attain the 1st and 2nd purposes of the above, the grinding method of this invention provides one of said grinding unit to one reduction roll, installs the grinding unit in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and grinds a reduction roll overall length with one emery wheel stone.
[0015]In order to attain the 1st and 2nd purposes of the above, the grinding attachment of this invention, The flat-surface type or the cup type emery wheel stone which has the grinding unit provided to the reduction roll in the rolling mill and with which said grinding unit grinds said reduction roll, A grinding stone driving device made to rotate said emery wheel stone and a grinding stone feed gear which pushes said emery wheel stone against said reduction roll, In on-line reduction roll grinding attachment provided with the traverse device made to move said grinding unit to a roll axial direction along with a sliding rail, Said emery wheel stone has the abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, makes size of said abrasive grain either No. 170/200 and No. 200/230, and is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence.
[0016]In order to attain the 1st and 2nd purposes of the above, the grinding attachment of this invention, Said emery wheel stone is attached to the side of the disk which rotates with said grinding stone driving device, and this disk, It shall have the annular abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, the width of the diameter direction of said annular abrasive grain layer shall be 30 mm - 50 mm, and it is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence.
[0017]In order to attain the 1st and 2nd purposes of the above, the grinding attachment of this invention is installed in the last stand or temper rolling mill of a continuous hot rolling mill sequence, and provides one of said grinding unit to one reduction roll.
[0018]In order to attain the 1st and 2nd purposes of the above, the rolling mill train of this invention, The flat-surface type or the cup type emery wheel stone which has the grinding unit provided to the reduction roll in the rolling mill and with which said grinding unit grinds said reduction roll, A grinding stone driving device made to rotate said emery wheel stone and a grinding stone feed gear which pushes said emery wheel stone against said reduction roll, It has a traverse device made to move said grinding unit to a roll axial direction along with a sliding rail, Said emery wheel stone has the abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, and installs the on-line reduction roll grinding

attachment which made size of said abrasive grain either No. 170/200 and No. 200/230 in a last stand.
[0019]

[Translation done.]

OPERATION

[Function]The reduction roll can do a level difference by wear in a rolling part and a non-rolling part with rolling. If continuous rolling of the steel plate of identical width is carried out, more portions equivalent to the rolled stock end of a rolling part than other portions of a rolling part will be worn out, and excessive abrasion will arise from a rolled stock end in the range of predetermined length. Although the range of the predetermined length which produces this excessive abrasion by that the plate edge part of rolled stock cools early, and becomes harder than other portions and load concentration in a plate edge part, and excessive abrasion produces changes with board thickness, the quality of a plate, etc., generally the range of it is 20 to about 50 mm from a rolled stock end. Having a thermal crown generally, it wears out uniformly and the rolling part except a rolled stock end part goes.
[0020]especially the surface disposition of the reduction roll of a last stand or a temper rolling mill is influenced also with the size of attachment ****** by the emery wheel stone to grind, and if abrasive grain size becomes fine, in connection with it, the surface disposition of a reduction roll will become good. However, in the grinding stone of not much fine abrasive grain size, the life of a grinding stone is too short and it cannot be used for actual on-line reduction roll grinding attachment.
[0021]By being what combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding, making the abrasive grain layer of an emery wheel stone from this invention, and making size of an abrasive grain into either No. 170/200 and No. 200/230, A reduction roll can be ground now to a good surface disposition for a long time, and grinding capability required for the emery wheel stone attached to the on-line reduction roll grinding attachment of the last stand of a continuous hot rolling mill sequence or a temper rolling mill and a grinding stone life can be attained.
[0022]Even if it makes quick speed which moves an emery wheel stone to a roll axial direction, it is necessary to make it the delivery mark of a grinding stone not remain in a rolling roll surface.
[0023]Using what has the annular abrasive grain layer which combined the cubic boron nitride abrasive grain or the diamond abrasive grain by resin bonding as an emery wheel stone of a grinding unit in this invention by the width of the diameter direction of an annular abrasive grain layer being 30 mm - 50 mm, While sending making grinding stone movement speed quick, and not leaving a mark but grinding to a good surface disposition, it can grind without being able to secure a grinding stone life and also starting clogging uniformly. Grinding capability required for the emery wheel stone attached to the on-line reduction roll grinding attachment of the last stand of a continuous hot rolling mill sequence or a temper rolling mill by this and a grinding stone life can be attained.
[0024]By providing one grinding unit to one reduction roll, and grinding a reduction roll overall length with one emery wheel stone in this invention, Even if a reduction roll can be ground to a good surface disposition, without producing a lap mark like [in the case of grinding with two or more grinding stones] and it grinds a reduction roll with the last stand and temper rolling mill of a continuous hot rolling mill sequence, rolled stock with good surface quality is rollable.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EXAMPLE

[Example]Hereafter, the example of this invention is described using a drawing. First, drawing 1 – drawing 10 explain the 1st example of this invention. In drawing 1 and drawing 2, the rolling mills in connection with this example are four stage rolling machines which have the reduction rolls (up-and-down work roll) 1a and 1a of the couple which extends the rolled stock S, and the reduction rolls (up-and-down reinforcement rolls) 1b and 1b (only one side is illustrated) of the couple which supports the reduction rolls 1a and 1a. The reduction rolls 1a and 1a are held by the bearing housing 3 and 3, and these bearing housing 3 and 3 is included in the operation side and the stands 4 and 4 of the driving side. The ON side guide 10 is arranged at the rolling mill ON side, and the guide to the reduction roll 1a of the rolled stock S is performed. The coolant header 15 (only one side is illustrated) which cools the heat of the reduction rolls 1a and 1a by which it is generated at the time of rolling is formed, and the heat of the reduction rolls 1a and 1a by which it is generated at the time of rolling is cooled.
[0026]The on-line reduction roll grinding attachment of this example is formed in such a rolling mill. On-line reduction roll grinding attachment has two or more grinding units 5 and 5 installed two pieces in this example in the one work roll 1a.
[0027]As shown in drawing 3 and drawing 4, each grinding unit 5, The disc-like emery wheel stone 20 which grinds the work roll 1a, and this emery wheel stone 20 via the grinding stone axis of rotation 21. It has the grinding stone driving device 22 to rotate, the grinding stone feed gear 23 which pushes the emery wheel stone 20 against the reduction roll 1a, and the traverse device 24 made to move the emery wheel stone 20 to the shaft orientations of the reduction roll 1a.
[0028]The emery wheel stone 20 has the sheet metal disk 52 which has the boss 52a, and the annular abrasive grain layer 51 fixed to the side by the side of the anti-boss of the sheet metal disk 52, and the sheet metal disk 52 is attached to the grinding stone axis of rotation 21 in the portion of the boss 52a. The sheet metal disk 52 has an elastic body function for absorbing the vibration from a reduction roll, and has the reduction roll 1a and structure which changes a flexure amount according to the contact force between the abrasive grain layers 51.
[0029]The abrasive grain layer 51 uses resin bonding for binding material, hardens the cubic boron nitride abrasive grain (generally referred to as CBN) or diamond abrasive grain which is superabrasive, and is made. The construction material of the sheet metal disk 52 is made from the aluminum material or the aluminum containing alloy for the purpose of radiating heat easily in the grinding heat from the superabrasive of the abrasive grain layer 51, and the purpose of lessening flexible region mass.
[0030]As the grinding stone axis of rotation 21 is shown in drawing 3, in order that only single-sided one side of the emery wheel stone 20 may be contacted to the reduction roll 1, minute angle ****** installation of 0.5 degree – the 1.0-degree intensity is carried out to the line right-angled in the axial center of the reduction roll 1a. By this, the line of contact of the abrasive grain layer 51 and the work roll 1a sees from the center of a grinding stone, and is formed only in one side, and, as for the sheet metal disk 52, an elastic body function can be exhibited effectively.
[0031]The hydraulic motor 54 (an electric motor may be used) rotated so that it may become a predetermined grinding stone peripheral speed about the emery wheel stone 20, as the grinding stone driving device 22 is shown in drawing 3, It has the belt pulley shaft 54b and the belt 55 which tell rotation of the output shaft 54a of the fluid motor 54 to the grinding stone axis of rotation 21, and the output shaft 54a and the belt pulley shaft 54b are connected via the parallel spline 54c. The belt pulley shaft 54b is supported by the body 59, enabling free rotation. The grinding stone axis of rotation 21 is supported movable [to shaft orientations] free

[rotation in the body 59] via the slide mold radial bearings 21a and 21b. The load cell 53 which measures the contact force of the emery wheel stone 20 and the work roll 1a is arranged at the anti-emery wheel stone side of the grinding stone axis of rotation 21.
[0032]The body 59 is stored by the case 25 and the hydraulic motor 54 is attached to the case 25. The body 59 is carried in the shaft orientations of the grinding stone axis of rotation 21 movable via the slide bearing 25a at the pars basilaris ossis occipitalis of the case 25, as shown in drawing 4.
[0033]The feed motor 57 attached to the case 25 as the grinding stone feed gear 23 was shown in drawing 3, The precompression type ball screw 56 of the backlash loess type which moves the body 59 in the attachment-and-detachment direction of the work roll 1a by rotation of the feed motor 57, and carries out cross feed of the emery wheel stone 20, the grinding stone axis of rotation 21, and the load cell 53 together, It has the encoder 57a which detects angle of rotation of the feed motor 57. Backlash loess type gear mechanics may be used instead of the precompression type ball screw 56.
[0034]The traverse motor 58 attached to the case 25 as the traverse device 24 was shown in drawing 4, The pinion 58a with which the axis of rotation of the traverse motor 58 is equipped and which gears with the rack 14, It is attached to the upper surface of the case 25, and has two pairs of guide idlers 26 (refer to drawing 2) which engage with one pair of guide rails 7a and 7b, and the encoder 58b which detects the number of rotations of the traverse motor 58. The guide rails 7a and 7b are attached to the rail frames 7 by which the diameter was carried out to the ON side of the reduction roll 1a along with the axial center of the reduction roll 1a as shown in drawing 2. The rack 14 is formed in the side by the side of the anti-reduction roll of the guide rail 7a. Thus, the grinding unit 5 is smoothly made movable in the direction of the roll-axes heart by engagement of rotation of the traverse motor 58, the pinion 58a, and the rack 14, supporting to the rail frames 7 via the guide idler 26 and the guide rails 7a and 7b.
[0035]It is necessary to make it the roll grinding unit 5 not interfere with the bearing housing 3 by the side of operation at the time of exchange of the reduction roll 1a. For this reason, the both ends of the rail frames 7 are slidably supported by the guide 9 attached to the stand 4 as shown in drawing 2, The grinding unit 5 can be moved now in the attachment-and-detachment direction of the reduction roll 1a together with the rail frames 7 with the rail moving system 30 (refer to drawing 1) of the operation side provided near the both ends of the rail frames 7, respectively, and a driving side. Each rail moving system 30 is provided with the oil hydraulic cylinder 11 by which pin connection of the tip was carried out to the rail frames 7.
[0036]The feed motor 57 of the grinding stone feed gear 22 and the traverse motor 58 of the traverse device 24 are controlled by the control device 13a to be shown in drawing 3. The hydraulic motor 54 of the grinding stone driving device 22 is driven with the fluid supplied from the hydraulic circuit 13c, and the hydraulic circuit 13c is also controlled by the control device 13a. The detecting signal of the encoder 57a of the load cell 53 and the grinding stone feed gear 23 and the encoder 58b of the traverse device 24 is sent and processed by the information processor 13b, and the result is sent to the control device 13a.
[0037]In this example constituted as mentioned above, by driving the emery wheel stone 20 positively with the grinding stone driving device 22 at high speed, grinding capability and a grinding stone life can be raised and it can grind for a long time. In this example, like the statement to JP,6-47654,A, since the emery wheel stone 20 can be ground correctly for a long time, without absorbing easily vibration which a reduction roll has and producing BIBIRI, it is effective in raising grinding capability and a grinding stone life further.
[0038]That is, the reduction roll 1a is vibrating, having the pitch of 10 to 150 C/S, although it depends also on rolling speed. When the roll grinder which has a common cylindrical grinding stone with off-line grinding attachment conventionally as on-line grinding attachment is attached, a cylindrical grinding stone and a reduction roll contact via the abrasive grain on the surface of a grinding stone, and while the metal and the abrasive grain of a roll surface collide, they come to grind.
[0039]When an abrasive grain and rolling roll surface metal contact, a reduction roll is ground, the following moment grinding stone separates from a reduction roll, and an abrasive grain cuts empty and rotates. Such discontinuous grinding will cause a BIBIRI phenomenon and will be irregular rolling roll surface and section.
[0040]If a grinding stone carries out the same vibration as vibration of a reduction roll, change of the contact force of a grinding stone and a reduction roll will not be generated. However, since reduction roll vibration is 150 c/ses and high frequency, flattery is difficult for vibrating a grinding stone and the whole grinding stone frame so that it may align with a reduction roll. If it does not try to miss vibration of a reduction roll with a grinding stone and the whole grinding stone frame, an elastic body function is given to the grinding stone itself and vibration is absorbed by bending of a grinding stone, since the mass of a flexible region becomes small,

vibration of a reduction roll will be followed promptly, and change of the contact force between a grinding stone and a reduction roll will become small.
[0041]An elastic body function is given to the grinding stone itself by giving an elastic body function to the sheet metal disk 52 which are some emery wheel stones 20 in this example, Rotating this emery wheel stone 20 so that the peripheral speed of the abrasive grain layer 51 may become 1600 m/min from 1000 m/min on a periphery, it pushes against the rotating reduction roll 1a, and it is sagged. The reduction roll 1a is vibrating forward and backward as mentioned above. Although the emery wheel stone 20 is pushed by this vibration, the sheet metal disk 52 bends then and the vibration from the reduction roll 1a is absorbed in an instant. Thereby, change of the contact force between the abrasive grain layer 51 and the reduction roll 1a serves as the small range of the elastic force produced in bending of the sheet metal disk 52, and can abolish a BIBIRI phenomenon.
[0042]In this example, in order to demonstrate effectively the elastic body function of the sheet metal disk 52, the grinding stone axis of rotation 21 is leaned so that the contact position of the abrasive grain layer 51 and the reduction roll 1a may be formed only in one side from the center of a grinding stone, as shown in drawing 3. If it does in this way, the sheet metal disk 52 can be bent by pressure to the reduction roll 1a in the form of a cantilever, and the vibration from the reduction roll 1a can be absorbed easily.
[0043]Since the elastic body function is given to the sheet metal disk 52 which is base metal supporting the abrasive grain layer 51 in this example, The mass which moves by the vibration from a reduction roll serves as only the abrasive grain layer 51 and the sheet metal disk 52, And since the high superabrasive (a cubic boron nitride abrasive grain or a diamond abrasive grain) of the grinding ratio (reduction volume / grinding stone reduction volume of a structure) in which prolonged grinding is possible is used by weight small to the abrasive grain layer 51, the mass of a flexible region becomes very small and the character frequency of the emery wheel stone 20 becomes high. For this reason, it can grind correctly for a long time, without producing the BIBIRI phenomenon according the vibrating reduction roll to resonance.
[0044]Next, the grinding method of this example is explained using drawing 5 - drawing 8.
[0045]The roll profile measured on-line is shown in drawing 5. As shown in this figure, if the reduction roll can do a level difference by wear in a rolling part (plate-leaping part) and a non-rolling part and carries out continuous rolling of the steel plate of identical width with rolling, more portions equivalent to the rolled stock end of a rolling part than other portions of a rolling part will be worn out. Generally, having a thermal crown, it wears out uniformly and a rolling part goes.
[0046]Other examples of a roll profile when the rolled stock of identical width is rolled are shown in drawing 6. This example is the roll profile measured off-line, and the thermal crown has disappeared. A dashed line is a survey roll profile among a figure, and a solid line is a theoretical roll profile (calculatively). If it continues rolling the 20 or more rolled stock (steel plate) S of identical width as shown in this figure, the wear level difference a will arise between a rolling part and a non-rolling part. If continuous rolling of the steel plate of identical width is carried out, more portions which hit rolled stock end Se than other plate-leaping parts will be worn out, and the excessive abrasion of the level difference b will arise from end Se of the rolled stock S into the portion of predetermined length c. Although this excessive abrasion is produced by that the plate edge part of rolled stock cools early, and becomes harder than other portions, and load concentration of a plate edge part and length c changes with board thickness, the quality of a plate, etc., according to an invention-in-this-application person's etc. examination, it is generally in the range of 20 to 50 mm. The inside [portion / of the length c] is worn out almost uniformly.
[0047]And it is shown in drawing 7. [the roll profile measured on-line] [a ** type] the inside of a figure, and A -- the end position of the reduction roll 1a -- B -- plate edge part Se of the rolled stock S -- only length [of excessive abrasion] c, C shows the roll axial direction middle position of the reduction roll 1a, and D shows the position of plate edge part Se of the rolled stock S for an inside position, respectively.
[0048]In order to remove first the wear level difference a produced with rolling, and the excessive abrasion level difference b in the grinding method of this example, In the range of A-D outside the portion which hits rolled stock S plate edge part Se, a required grinding amount is calculated from the difference of a target roll profile and a survey roll profile, the contact force of the reduction roll 1a and the emery wheel stone 20 is calculated from this required grinding amount, and this is ground as setting-out contact force. Since the shape change by wear is large, the contact force of the reduction roll 1a and the emery wheel stone 20 is similarly controlled by the difference of a target roll profile and a survey roll profile, and the portion of length c of excessive abrasion, i.e., the range of D-B, is ground.

[0049]since it becomes the roll profile which, on the other hand, had the curvature of about 1 law which has a thermal crown in the range of B-B inside the portion of length c of excessive abrasion, contact force of the reduction roll 1a and the emery wheel stone 20 is not changed, but it grinds by fixed contact force.
[0050]Change of contact force when it grinds as mentioned above is shown in drawing 8. Only the predetermined length containing excessive abrasion length c divides the grinding range of the reduction roll 1a into 1st range A-B of the roll axial direction outside, and 2nd range B-B of the roll axial direction inside from the both ends of a rolling part bordering on the inside roll axial direction position B, At 1st range A-B, the contact force of the reduction roll 1a and the emery wheel stone 20 is controlled by the difference of a target roll profile and a survey roll profile, and it grinds, and by 2nd range B-B, it controls and grinds so that the contact force of the reduction roll 1a and the emery wheel stone 20 may become fixed. A rolling part is ground by grinding the 2nd range by fixed contact force by the good surface disposition which does not have nonuniformity in surface roughness.
[0051]The grinding capability of 2nd range B-B that is a portion into which a rolling part is worn out almost uniformly here requires that the excessive abrasion level difference b by end Se of the rolled stock S (refer to drawing 6) should be removable. 0.6 micrometerm That is, if one coil of excessive abrasion level differences b generally made in end Se of the rolled stock S are rolled, they will be produced from 0.3. It controls to become the grinding capability for this level difference to grinding be removable. Grinding capability is decided from the axial movement speed (traverse speed) of the reduction roll 1a, and the contact force (forcing power of the emery wheel stone 20) of the emery wheel stone 20 and the reduction roll 1a of the emery wheel stone 20, or the number of rotations of the emery wheel stone 20. Therefore, the fixed contact force in 2nd range B-B is set up become the grinding capability for the excessive abrasion level difference b made in rolled stock end position to be removable.
[0052]The level difference part of the roll profile produced by wear can be made flat, without changing the form of a thermal crown by grinding the reduction roll 1a as mentioned above.
[0053]The reduction roll grinding attachment of this example enforces the above grinding method, and shows drawing 9 the control procedure with a flow chart. These control procedures are beforehand stored in the information processor 13b as a program.
[0054]First, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a, and the profile of a roll overall length is measured (Step 100). The roll profile measuring method performed using the grinding attachment of this on-line can use the method of a statement for JP,6-47654,A, and mentions it later about that example. Next, the required grinding amount between A-B is calculated from the difference of a target roll profile and a survey roll profile, the contact force of the reduction roll 1a and the emery wheel stone 20 is calculated from this required grinding amount, and this is made into setting-out contact force (Step 101). The position of a target roll profile and B is beforehand memorized to the information processor 13b. Subsequently, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a, and grinding is started (Step 102). At this time, the information processor 13b always recognizes the grinding position of a roll axial direction from the detecting signal of the encoder 58b of the traverse motor 58 (Step 103), The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force of the reduction roll 1a and the emery wheel stone 20 which were measured by the load cell 53 turns into contact force which calculated as mentioned above and was set up, when a grinding position is between A-B (Step 104). The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force measured by the load cell 53 turns into fixed contact force, when a grinding position is between B-C (Step 105). The fixed contact force is also beforehand memorized to the information processor 13b. If grinding of a roll overall length is completed, the number of times of grinding will be counted (Step 106,107), and it is judged whether the number of times of grinding reached the number of times of specification (Step 108). The number of times of specification grinding is 5 to 6 times, and this number of times is also beforehand memorized to the information processor 13b. If it returns to Step 102, processing of the above-mentioned steps 103-108 is repeated and the number of times of specification is reached when the number of times of grinding does not reach the number of times of specification, it will return to Step 100, a roll profile will be measured again, and processing of the above-mentioned steps 101-108 will be repeated. It continues during rolling and the above roll grinding is carried out.
[0055]An example of the procedure of the roll profile measurement in Step 100 is explained using drawing 10. This procedure is also stored in the information processor 13b as a program. First, the emery wheel stone 20

of one grinding unit 5 is pushed against the operation side edge part of the work roll 1a (Step 300). Next, the traverse motor 58 is rotated and the grinding unit 5a is moved to a roll axial direction (Step 301). The contact force of the abrasive grain layer 51 and the work roll 1a is measured by the load cell 53 during this movement, A feed position is controlled by the feed motor 57 so that the contact force becomes fixed (Step 302), and the feed per revolution of the emery wheel stone 20 is computed with the signal from the encoder 57a of the feed motor 57 (Step 303). It can come, simultaneously the position of the roll axial direction of the grinding unit 5a is measured with the signal from the encoder 58b of the traverse motor 58 (Step 304). And a roll profile is computed from the position of a roll axial direction, and the feed per revolution of an emery wheel stone (Step 305). A procedure with the same said of the grinding unit 5 of another side is carried out, and a roll profile is computed (Step 306). However, movement of a roll axial direction is performed from a driving-side end. The roll profile for which it asked by movement of the two grinding units 5 and 5 is compounded, and the profile of the overall length of the work roll 1a is determined (Step 307). On-line grinding attachment can be used by the above, and the profile of a reduction roll can be measured on-line.

[0056]It may be the method of fixing a feed position to JP,6-47654,A like a statement as a method of measuring a roll profile using on-line grinding attachment, and measuring change of contact force. An on-line profile meter for exclusive use may be installed, and the detection value may be used.

[0057]A reduction roll can be ground to the optimal roll profile and surface disposition for rolling, without not leaving the excessive abrasion level difference which causes an edge build up by the above according to this example, and changing the form of a thermal crown.

[0058]In the last stand and temper rolling mill of a continuous hot rolling mill sequence, the homogeneity of the board thickness of rolled stock, the gloss on the surface of rolled stock, and surface roughness are greatly influenced according to the roll profile and surface disposition of the reduction roll ground by on-line reduction roll grinding attachment. By forming the on-line reduction roll grinding attachment of this example in the last stand and temper rolling mill of a continuous hot rolling mill sequence, and grinding a reduction roll, rolled stock with uniform board thickness and good surface quality can be manufactured.

[0059]Drawing 11 explains the 2nd example of this invention.

[0060]In the 1st example, it is ground in the range of B-C by the same shape as the worn-out shape by only predetermined length's fixing contact force in 2nd inside range B-C, and grinding it bordering on the inside roll axial direction position B, from end Se of the rolled stock S. Therefore, this method is a convenient method when it wears out in right-and-left homogeneity in the range of B-C. However, it is necessary to grind so that it may become a symmetrical roll profile, when not wearing out uniformly in the range of B-C but wearing out in right-and-left unevenness. Therefore, it is necessary to set up a target roll profile, and to change and grind the contact force of the reduction roll 1a and the emery wheel stone 20 by a place from the difference of a target roll profile and a survey roll profile also in this range. However, when the difference of the contact force of the reduction roll 1a and the emery wheel stone 20 is enlarged too much by a place even in this case, in the case of a rolling part, a reduction roll 1a surface disposition changes by a place, and there is a possibility that this may transfer to the rolled stock S and may worsen surface quality.

[0061]By changing the gain which calculates the contact force of the reduction roll 1a and the emery wheel stone 20 in the range of A-B of a roll end, and the range of B-C of a rolling part even if the difference of a target roll profile and a survey roll profile is the same in the grinding method of this example, the difference of the contact force with a small rolling part in which a roll end becomes a difference of bigger contact force -- it is made to become Since the roll profile error by grinding also becomes small even when the roll profile measured by making small the gain which calculates the contact force of a rolling part has an error, Change of the roll surface description in a rolling part decreases, and rolled stock with good surface quality can be manufactured.

[0062]A flow chart shows the control procedure of the reduction roll grinding attachment for enforcing the above-mentioned grinding method to drawing 11.

[0063]First, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a like the 1st example, and the profile of a roll overall length is measured (Step 500). Next, the required grinding amount between A-B and between B- is calculated from the difference of a target roll profile and a survey roll profile, The contact force setting-out gain G is changed, contact force is calculated so that change of the contact force over the roll profile difference between B-C more nearly same than between [this required grinding amount to] A-B may become small, and this is made into setting-out contact force (Step 501). That is, when Z'(x) and a contact force transformation constant are set to K and

a gain is set [a target roll profile] to G1 and G2 for Z(x) and a survey roll profile, between A-B, it is P(x)=KG1 {Z(x)-Z'(x)}. -- (1)
It comes out, contact force P(x) is calculated, and it is P(x)=KG2 between B-C {Z(x)-Z'(x)}. -- (2)
It comes out and contact force P(x) is calculated. Here, {Z(x)-Z'(x)} is the difference of a target roll profile and a survey roll profile, i.e., a required grinding amount, and the gain G1 and G2 have a relation of G1>G2. It is set as G1=1 and G2=0.5 as an example. The above-mentioned formula (1) and (2) is beforehand memorized to the information processor 13b with the position of the gain G1, G2, and B.
[0064]Subsequently, it is made to move to a roll axial direction, pushing the emery wheel stone 20 of the two grinding units 5 and 5 against the work roll 1a, and grinding is started (Step 502). At this time, the information processor 13b always recognizes the grinding position of a roll axial direction from the detecting signal of the encoder 58b of the traverse motor 58, The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force of the reduction roll 1a and the emery wheel stone 20 which were measured by the load cell 53 turns into contact force calculated and set up by the above-mentioned formula (1), when a grinding position is between A-B, The feed per revolution of the feed motor 57 of the grinding stone feed gear 23 is controlled so that the contact force measured by the load cell 53 turns into contact force calculated by (2) in above one, when a grinding position is between B-C (Step 503). If grinding of a roll overall length is completed, the number of times of grinding will be counted (Step 504,505), and it is judged whether the number of times of grinding reached the number of times of specification (Step 506). The number of times of specification grinding is 5 to 6 times, and this number of times is also beforehand memorized to the information processor 13b. If it returns to Step 502, processing of the above-mentioned steps 503-506 is repeated and the number of times of specification is reached when the number of times of grinding does not reach the number of times of specification, it will return to Step 500, a roll profile will be measured again, and processing of the above-mentioned steps 501-506 will be repeated. It continues during rolling and the above roll grinding is carried out.
[0065]A reduction roll can be ground to the optimal roll profile and surface disposition for rolling, without not leaving the excessive abrasion level difference which causes an edge build up also by this example, and changing the form of a thermal crown by the above. Even if it grinds the last stand of a continuous hot rolling mill sequence, and the reduction roll of a temper rolling mill, grinding of the on-line which keeps the surface quality of rolled stock good is attained.
[0066]Drawing 12 - drawing 15 explain the 3rd example of this invention. This example installs the rolling mill provided with the on-line reduction roll grinding attachment of this invention in the last stand of a continuous hot rolling mill sequence.
[0067]In drawing 12, the continuous hot rolling mill sequence of this example arranges six sets of the rolling mills 80-85 to the 6th stand to a tandem, and comprises the 1st stand, and the on-line reduction roll grinding attachment of this invention is formed in the rolling mill 85 of the last stand (the 6th stand). This reduction roll grinding attachment has the grinding unit 5 arranged one piece at a time to the up-and-down reduction rolls 1a and 1a, respectively. The composition of others of reduction roll grinding attachment including the composition of the grinding unit 5 is the same as the 1st example except for the point that the control device 13a and the information processor 13b (refer to drawing 3) function as controlling to grind the overall length of the reduction roll 1a with the one grinding unit 5.
[0068]In drawing 13, the emery wheel stone 20 of the grinding unit 5, As the 1st example explained, it is attached to the side of the sheet metal disk 52 and the sheet metal disk 52, and have the annular abrasive grain layer 51 which used resin bonding for binding material, hardened the cubic boron nitride abrasive grain or the diamond abrasive grain, and was made, but. The sizes of the abrasive grain of the abrasive grain layer 51 are either No. 170/200 and No. 200/230. The width (grinding stone width) W of the diameter direction of the annular abrasive grain layer 51 is 30 mm - 50 mm.
[0069]Since the reduction roll 1a surface disposition which was ground unlike other stands transfers to the rolled stock S when on-line reduction roll grinding attachment is formed in the last stand of a continuous hot rolling mill sequence, More than on-line reduction roll grinding attachment heightens grinding capability, to maintain a reduction roll 1a surface disposition good is desired.
[0070]The experimental result about the difference in the roll surface grinding relative roughness by the difference in the abrasive grain particle size of a grinding stone is shown in drawing 14. The range of the arrow at a given abrasive grain particle size of this figure shows the range of roll surface relative roughness. The experimental result about the relation between the difference in the abrasive grain particle size of a grinding

stone and the difference in a grinding ratio (abrasion loss of ********/grinding stone of a structure) is shown in drawing 15. The range of the arrow at a given abrasive grain particle size shows the range of a grinding ratio. The grinding conditions in these experimental results are as follows.
roll (abrasives): -- nickel grain roll roll-rotational-speed: -- 300 - 600 m/min grinding stone revolving speed: -- 1200 m/min contact force: -- 300N grinding stone traverse speed: -- 10 - 20 mm/s upcutting grinding (it grinds in the state where the hand of cut and grinding stone hand of cut of a roll are reverse)
Grinding-stone width: 40 mm.
[0071]According to an invention-in-this-application person's etc. examination, when the reduction roll 1a surface disposition ground by on-line reduction roll grinding attachment in the last stand was from average-of-roughness-height Ra0.9micrometerm in the surface state with unevenness more than 1.0 micrometerm, it turned out that this unevenness transfers to the rolled stock S as a grinding eye. For this reason, in order to avoid this, it is necessary to grind a reduction roll 1a surface disposition in the state of unevenness below 1.0 micrometerm from average-of-roughness-height Ra0.9micrometerm. It is needed that the particle size of the abrasive grain of the abrasive grain layer 51 made with cubic boron nitride (CBN) or a diamond abrasive grain from drawing 14 is finer than this including #170/200. On the other hand, if the particle size of an abrasive grain is made fine, the average of roughness height of the reduction roll 1a will improve, but as shown in drawing 15, **** of an abrasive grain becomes early rapidly. This is because binding material is resin bonding when an abrasive grain becomes small, so the power supporting an abrasive grain becomes small, an abrasive grain is easily omitted and wear of the abrasive grain layer 51 becomes early. an abrasive grain particle size -- # -- since a grinding stone life will be 2 or 3 days and exchange of a grinding stone is frequently needed when it becomes fine 230/270 or more, it will be necessary to stop rolling for grinding stone exchange, and the effect of on-line roll grinding attachment will be lost greatly.
[0072]As mentioned above, grinding capability required for the emery wheel stone 20 attached to the on-line reduction roll grinding attachment of a last stand and a grinding stone life can be attained by making the abrasive grain particle size of the abrasive grain layer 51 in the emery wheel stone 20 into No. 170/200 or No. 200/230.
[0073]When the distance which an emery wheel stone moves during 1 rotation of the reduction roll 1a in a roll axial direction became 1/3 or more [of the width W of the abrasive grain layer 51, i.e., grinding stone width,] according to an invention-in-this-application person's etc. examination, it turned out that it is easy to generate the delivery mark of a grinding stone. At for example, the time of the roll diameter of 700 mm, and roll-rotational-speed 300 m/min. The roll axial direction movement speed (permission grinding stone movement speed) of the emery wheel stone 20 in case the grinding stone width W shall be 20 mm, 30 mm, and 40 mm and only /3 of the grinding stone width W moves, Respectively, it is grinding stone width W20mm. Permission grinding stone movement speed It can become 15 mm/s 30mm 22.7 mm/s 40mm 30 mm/s 50mm 37.5 mm/s 60mm 45.4 mm/s, it can send, so that the grinding stone width W is wide, and it cannot leave a mark, but grinding stone movement speed can be made quick.
[0074]On the other hand, even if the emery wheel stone 20 makes the same contact force of the abrasive grain particle size of the abrasive grain layer 51, the reduction roll 1a, and the emery wheel stone 20, the life of a grinding stone changes with grinding stone width W. For example, even if it grinds the reduction roll 1a with the grinding stone of #170/200 with a CBN abrasive grain, it becomes the grinding ratio 120 at grinding stone 40 mm in width to the grinding ratio 50 by grinding stone 20 mm in width. That is, when the one where grinding stone width is wider does not come out of grinding stone movement speed as much as possible quickly as mentioned above, a grinding ratio becomes large and the same grinding capability is required for this reason, in the one where grinding stone width is wider, a grinding stone life becomes a long time. However, if grinding stone width W is made large too much, a peripheral-wheel-speed difference becomes large by the peripheral part and inner periphery of the annular abrasive grain layer 51, it will become difficult to contact uniformly and to grind or clogging will arise in the inside to which peripheral wheel speed becomes slow relatively.
[0075]As mentioned above, while sending the grinding stone width W of 30 to 50 mm being good, and especially around 40 mm being the optimal, and making grinding stone movement speed quick by this, and not leaving a mark but being able to grind the reduction roll 1a to a good surface disposition, It can grind without being able to secure a grinding stone life and also starting clogging uniformly.
[0076]In the last stand of continuous rolling equipment, it can prevent being ground and a roll surface transferring a grinding eye etc. to the rolled stock S by grinding using the emery wheel stone 20 which attached the above abrasive grain layers 51. However, if it grinds using two or more emery wheel stones 20 to the one

reduction roll 1a, the place in which the emery wheel stone 20 carries out a lap on the reduction roll 1a surface will be generated. The surface disposition of the reduction roll 1a of this position that carried out the lap differs from others, though very small. At this example, it grinds with the one emery wheel stone 20 to the one reduction roll 1a from one end of the reduction roll 1a to the end of another side with the rolling mill of the severe above-mentioned last stand of the surface disposition of the rolled stock S. The rolled stock S which has good surface quality by this is rollable.

[0077]Although this invention was applied to the last stand of continuous hot rolling equipment as a severe rolling mill of the surface disposition of the rolled stock S in the 3rd example, if it is a severe rolling mill of the surface disposition of the rolled stock S, this invention is applicable besides it. For example, the same effect is acquired even if it applies this invention to a temper rolling mill, although a graphic display is not carried out.

[0078]Although some desirable examples of this invention were described above, it can change variously within the limits of the pneuma of above-mentioned example this invention. For example, although it shall have the flat-surface type emery wheel stone which attached the abrasive grain layer annular in a sheet metal disk as an emery wheel stone in the above-mentioned example, this invention can be similarly applied to the cup type emery wheel stone which attached the cup type grindstone member to the base circle board, and the same effect can be acquired.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is with the partial section side view of the important section of the rolling mill provided with the on-line reduction roll grinding attachment by the 1st example of this invention.
[Drawing 2]It is a partial section top view excising and showing some rolling mills shown in drawing 1.
[Drawing 3]It is a figure showing the horizontal sectional view of a grinding unit with a control device and an information processor.
[Drawing 4]It is the vertical cross section of a grinding unit.
[Drawing 5]It is a figure showing the roll profile measured using on-line roll grinding attachment. ("Iron and Steel Institute of Japan" Nishiyama commemoration technical lecture "rolling mill which has roll profile change device" Sumitomo Metal **** ******.)
[Drawing 6]It is a figure showing a roll profile when the rolled stock of identical width is rolled. ("Iron and Steel Institute of Japan" Nishiyama commemoration technical lecture "rolling mill which has roll profile change device" Sumitomo Metal **** ******.)
[Drawing 7]It is a figure [-izing / **/ the roll profile measured on-line / a figure / type / in which showing it] and and.
[Drawing 8]It is a figure showing change of contact force when grinding a reduction roll with the roll profile shown in drawing 7 according to the 1st example.
[Drawing 9]It is a flow chart which shows the control procedure of the reduction roll grinding attachment by the 1st example.
[Drawing 10]It is a flow chart which shows the details of the roll profile measuring process procedure in the flow chart of drawing 9.
[Drawing 11]It is a flow chart which shows the control procedure of the reduction roll grinding attachment by the 2nd example of this invention.
[Drawing 12]It is a schematic diagram of the continuous hot rolling mill sequence by the 3rd example of this invention.
[Drawing 13]It is a front view of an emery wheel stone.
[Drawing 14]It is a figure showing the relation between the abrasive grain particle size of an emery wheel stone, and roll surface grinding relative roughness.
[Drawing 15]It is a figure showing the abrasive grain particle size of an emery wheel stone, and the relation of a grinding ratio.
[Description of Notations]
1a: Reduction roll (up-and-down work roll)
1b: Reduction roll (up-and-down reinforcement rolls)
3: Bearing housing
4: Stand
5: Grinding unit
7: Rail frames for a traverse
13a: Control device
13b: Information processor
14: Rack
20: Emery wheel stone
21: Grinding stone axis of rotation

22: Grinding stone driving device
23: Grinding stone feed gear
24: Traverse device
58: The motor for a traverse
85: The last stand of a continuous hot rolling mill sequence

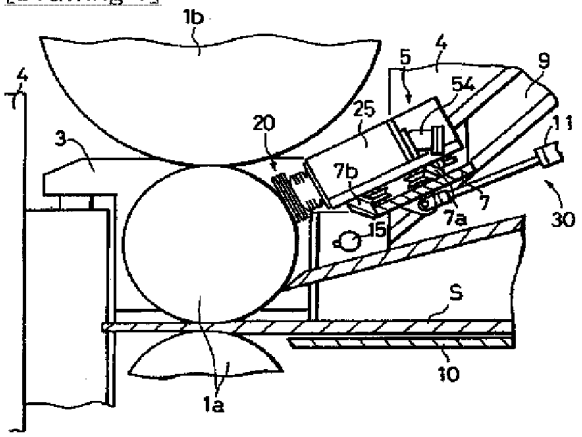
[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

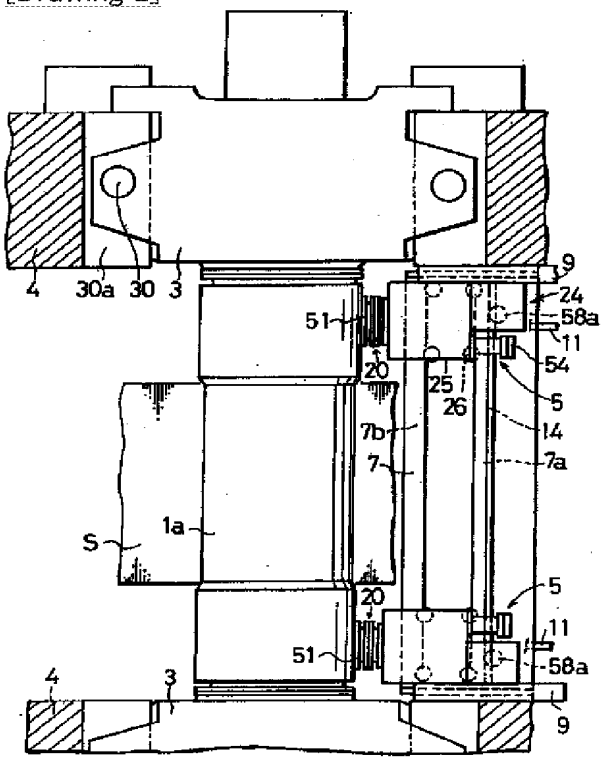
DRAWINGS

[Drawing 1]

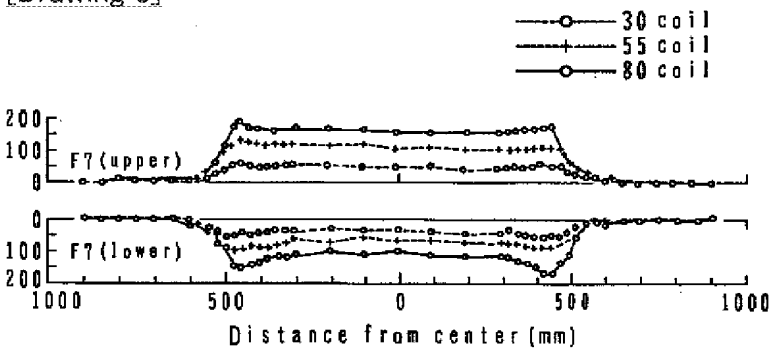


1a:圧延ロール(上下作業ロール)
1b:圧延ロール(上下補強ロール)
3:軸受箱
4:スタンド
5:研削ユニット
7:トラバース用レール

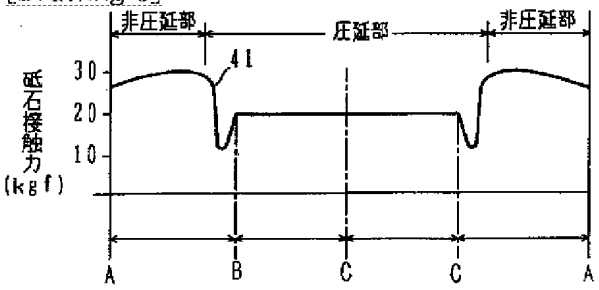
[Drawing 2]



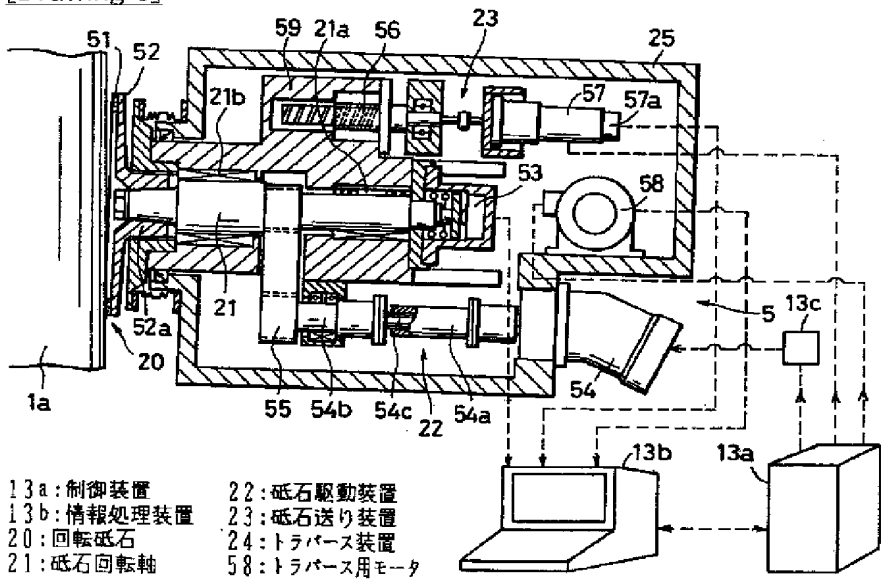
[Drawing 5]



[Drawing 8]



[Drawing 3]



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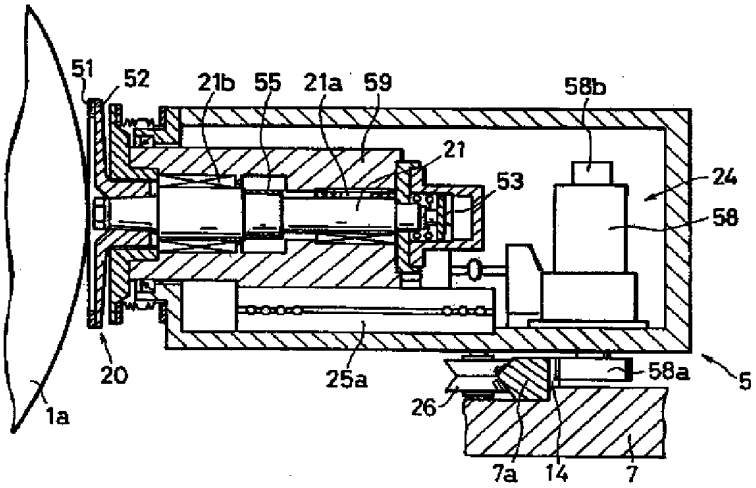

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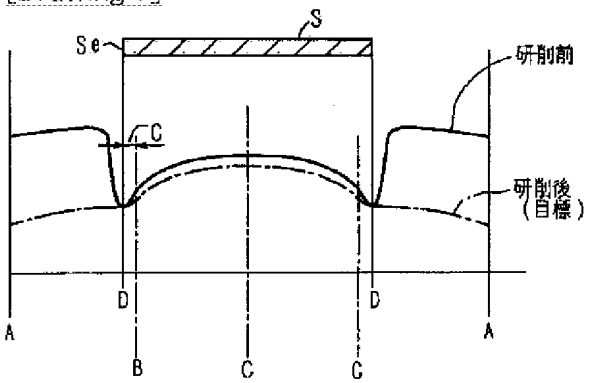
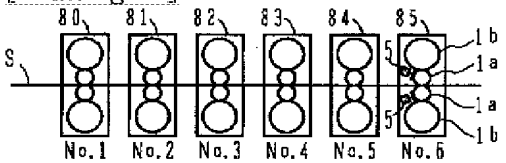
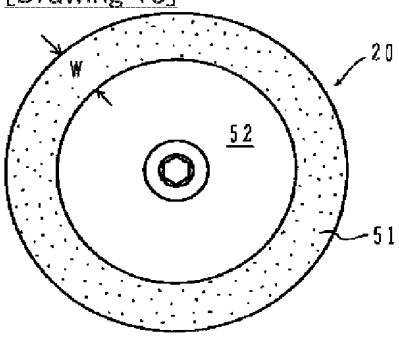


[Drawing 12]



85:連続熱間圧延機列の最終スタンド

[Drawing 13]



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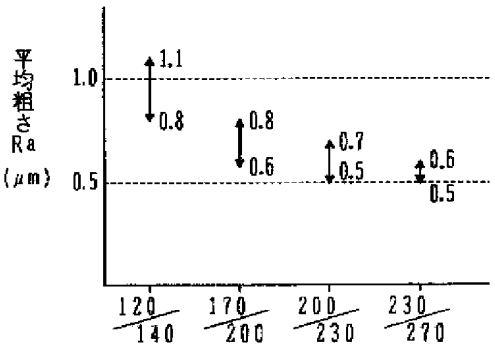

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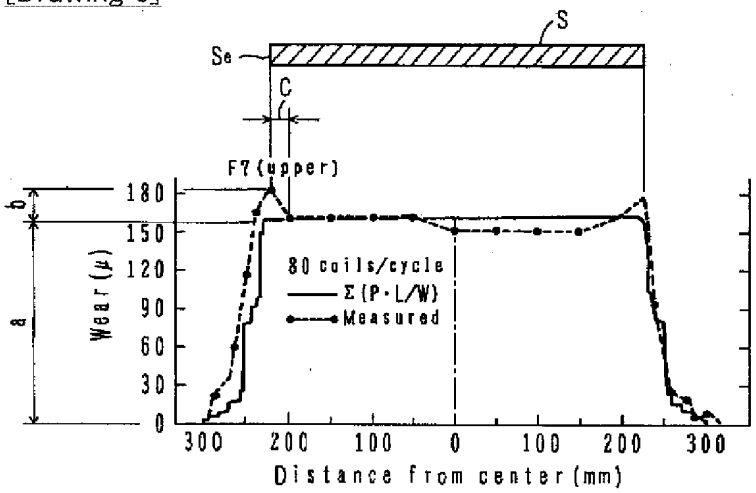

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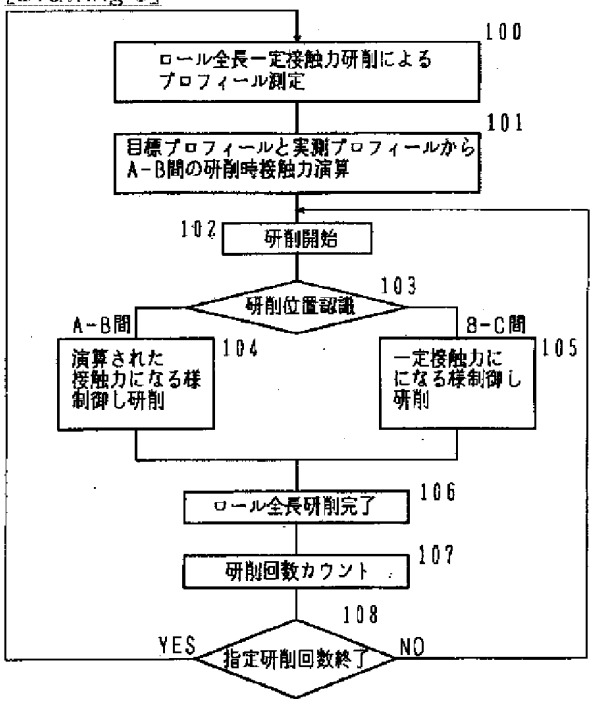

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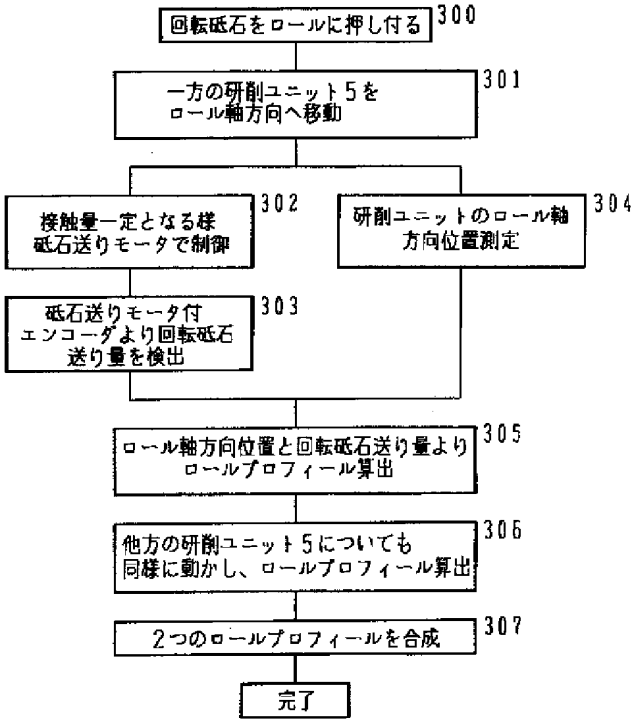

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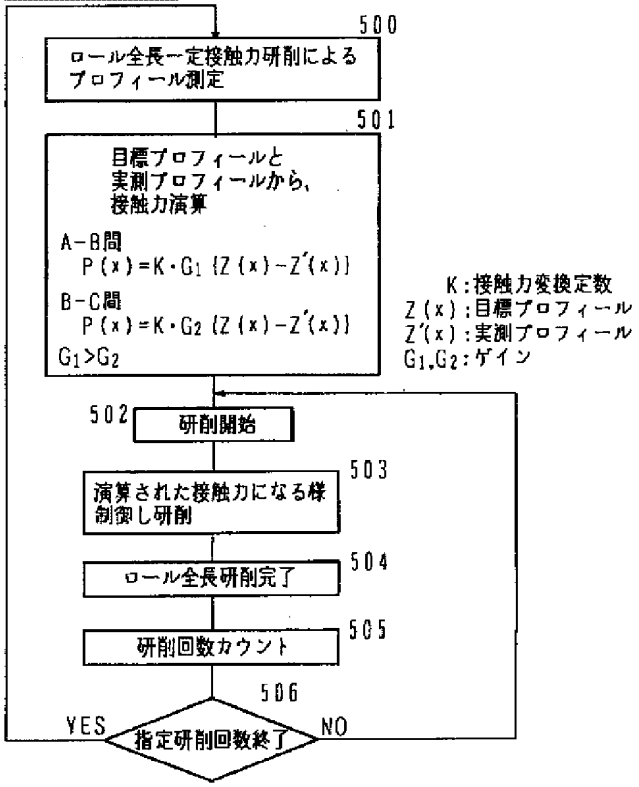
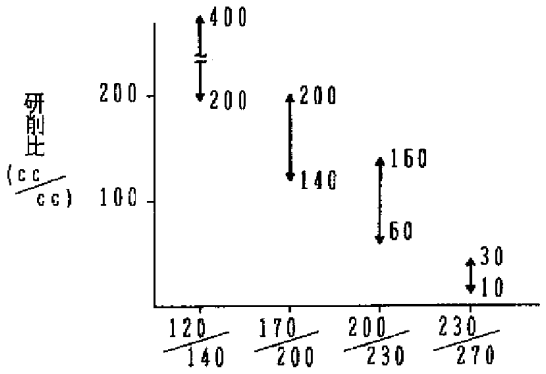


[Drawing 15]



[Translation done.]